Appendix

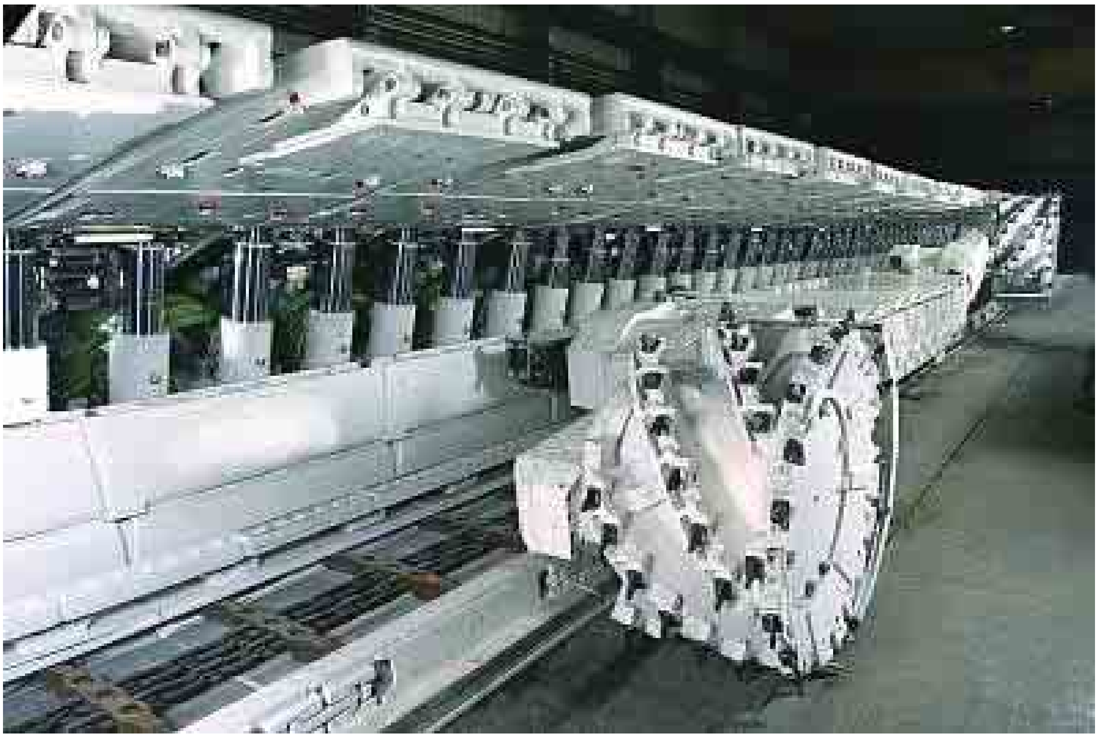
C

Underground Concept Study

IDEMITSU AUSTRALIA RESOURCES PTY LTD

BOGGABRI COAL UNDERGROUND CONCEPT STUDY

Final Report 6th November 2009



Project	Boggabri Coal Underground Concept Study	
Revision:	A (Draft)	FINAL
Date:	23/10/2009	6/11/2009
Prepared by:	D. Boyd	D. Boyd
Checked by:	W. Sly	W. Sly

EXECUTIVE SUMMARY

Introduction

The Boggabri resource is located within the Gunnedah basin of NSW approximately 300km north-west of Newcastle and 15km north-east of the township of Boggabri. Mining by opencut methods commenced in 2006 and is currently producing at 1.5Mtpa. Product coal is transported by road haulage to a rail siding 14km west of the mine and then railed to the port of Newcastle for export. The mine produces a low ash thermal coal product.

Idemitsu Australia Resources Pty Ltd controls the mining operation through its 100% ownership of subsidiary Boggabri Coal Pty Ltd. Idemitsu commissioned this conceptual study into alternative underground options for the lease areas currently undergoing, or planned to undergo, opencut exploitation. This was deemed necessary as part of the Environmental Approval process for extending the current approved opencut mining area.

The study was broad focused with estimate values at between +/- 30%. The study investigated various mining methods and access options making recommendation of mining by longwall and access via the completed opencut highwall. The application of Longwall Top Coal Caving in the upper Braymont Seam was flagged as potentially viable for improving recovery of the thicker coal measures in this seam. The study investigated all likely infrastructure and capital costs including coal processing and handling. Impacts on the environment and community were accessed together with an estimation of total land disturbance required for setting up the mine. A broad level risk assessment was completed to define what are likely to be the major risks for an underground operation.
All capital and operating costs together with a mine production schedule were modeled indicating a 5.0Mt per annum operation could be established, sustainable over a 20 year time frame at an annual operating cost of slightly over $20/ROM tonne.

Resource Setting

The Boggabri deposit is covered by three leases with a combined area of over 4,000 Ha. Of this total 3,144 Ha is potentially available to opencut and or underground mining with the balance available to underground mining only. The deposit contains some 17 seams in total, 8 of which are planned to be mined or exposed by the long term opencut mine plan. To keep the underground study as a direct comparison to the opencut planning options, only those seams within the long term opencut projection and within the lease areas available to opencut mining where examined in the underground study.

The deposit has been extensively drilled with over 450 exploration boreholes with a total resource of 196.4Mt identified within the upper opencut seam horizons. The topography is dominated by a ridgeline that wraps around all three lease areas with relatively mild slopes within the central part of the deposit and with steeper escarpments around the edges. The height above sea level varies from 270m at the ROM crusher area to 460m along the western boundary. The upper seams vary in depth from surface outcrop to over 250m.

Of the 8 seams available for underground mining, three were identified as having economic potential. These included the upper Braymont and the under-laying Jeralong and Merriown seams. The remaining upper level seams were either too narrow or had insufficient area between the outcrop and the lease boundary to warrant development cost.

Mine Access and Layout

The mine access strategy was developed on the basis of utilisation of the projected 2011 face position for the opencut highwall. This was seen as presenting the lowest cost option with all three targeted underground seams having their own bench from which to access the coal reserves. Use of the opencut would also assist in minimising the amount of additional surface disturbance required by utilising existing land area disturbed by the open cut.

The preferred mine orientation was a continuation of the north-west / south-east alignment of the opencut highwall for the Mains, projected through to the northern lease boundary. With this alignment sub panels can then be laid on a north-east / south-west alignment from both sides of the Mains until lease boundaries, physical lox-lines or depth of cover limitations were met.

Coal clearance would be achieved by a series of “in-pit” conveyors linking the underground levels with an overland conveyor. The overland conveyor would be in two sections to skirt around the planned opencut spoil pile. Some realignment of the spoil pile was proposed to minimise the length of overland conveyor required.

Mine ventilation would be provided by surface main fans sitting on top of a ventilation shaft. The shaft would be established close to the mine entries where the depth of cover to the deepest Merriown seam is 73m. A six heading mains split evenly between intake and return roadways would allow for minimisation of collar pressures and the risk of spontaneous combustion. The main electrical sub-station would also be established at this general location with access easily achieved from the Leard Forest Road. Power would be reticulated from a continuation of the main feeder line following the proposed overland conveyor around the back of the final open cut highwall to the fan and sub-station location.

Mine Design

Three methods of mining where investigated for the concept study including Longwall, Place Change and Wongawilli. The Longwall method was selected for its superior resource recovery and productivity rates, its flexibility to handle a range of mining heights, its good control over spontaneous combustion and its wide utilisation in the Australian underground coal mining industry.

The longwall was designed using 250m wide faces with dual heading gateroads and 25m wide chain pillars. This was seen as a good compromise between modern longwall capability, with faces up to 370m now common, and flexibility to utilise the non uniform resource shape and boundaries. Roadway widths were kept tight at 5.0m to aid in gateroad stability.

Research into multi seam mining and minimum interburdens was conducted for the purpose of the study. This research based extensively on US experience indicated that mining as low as 7.5m between seams is possible so long as the ratio of overburden to interburden is kept below 16 as a maximum cut off. The mine design utilised this criteria particularly for the Merriown seam which has the smallest average interburden depth to the overlaying Jeralong seam.

The design of Mains and Gateroad pillars was based on the principal of panel superimposition between the three mining horizons. The vertical alignment of pillars ensures stress distribution is maintained within the pillar core. Pillar widths were based on the worst case depth of cover to the Merriown seam. This resulted in additional factor of safety for the overlying Jeralong and Braymont seams.

Mine Infrastructure

The study identified the infrastructure required to establish and process the output from underground operations to the existing truck haulage load-out facility. Facilities investigated included, mine access roads and offices, coal clearance systems both surface and underground, coal processing, tailings disposal, power reticulation, air and water reticulation, mine dewatering, mine ventilation, fire fighting services, underground communications and gas monitoring and the provision of other ancillary services (stonedust, diesel, ballast etc).

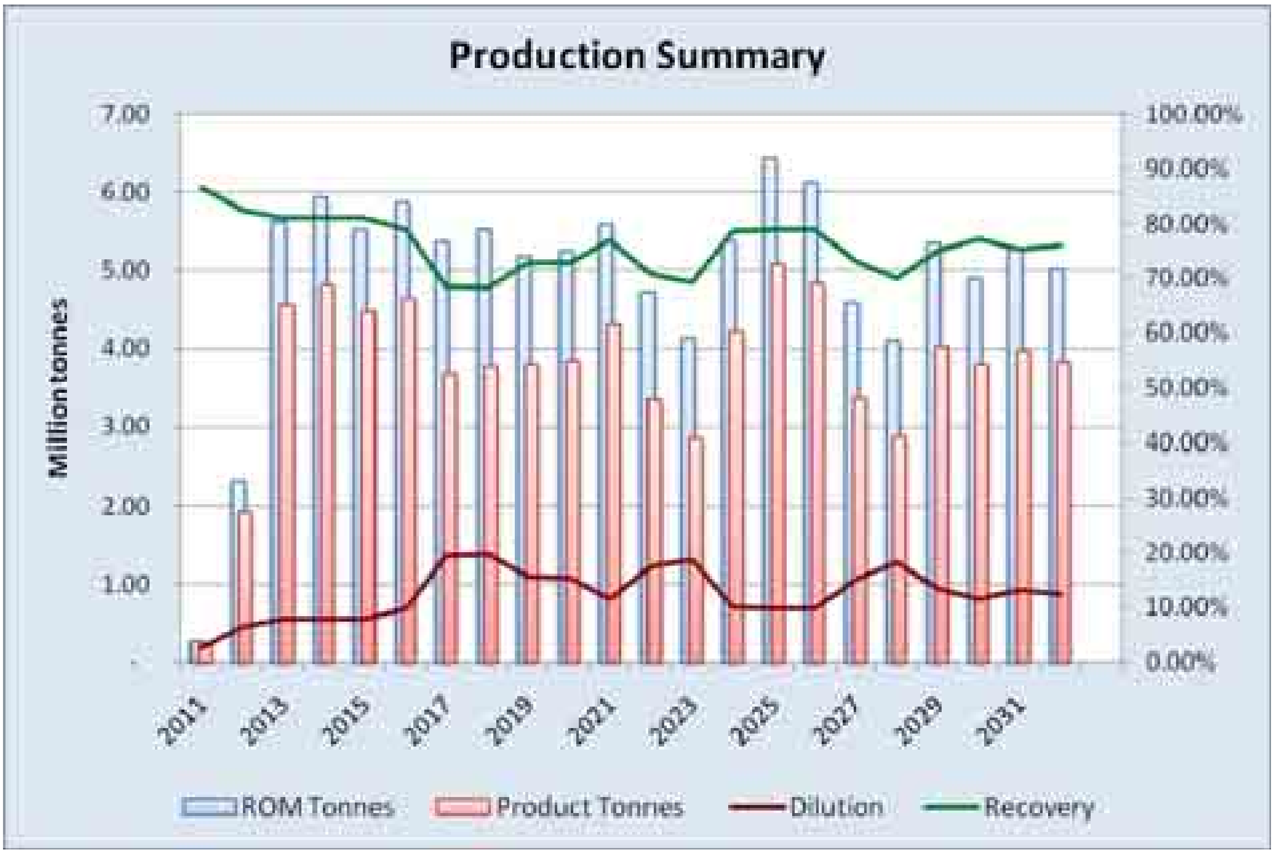
Productivity and Economic Evaluation

The mine schedule was based on 364 days a year production with one 24 hour shut down for Christmas day. Two 10 hours shifts were allowed for, in keeping with Idemitsu safety and health policy, leaving 4 hours each day as a maintenance window.

Mains and gateroad road development were conservatively estimated at 12 and 15 m/shift respectively with the longwall retreating at 10 m/shift in normal operation and 6.4 m/shift during top coal operation. An allowance of 14 days for bolt up phase, and 25 days for relocation, were made for each longwall move.

Total ROM mine production under this arrangement ranges between 4.1 and 6.4Mtpa with an average production of 5.3Mtpa. Mine dilution is expected to range between 12.8% peeking at 19.8% when mining through seam split zones. Recoveries of between 68-86% are predicted, resulting in an average coal quantity produced after washing of 4.0Mtpa. A total mineable coal reserve of 94.6Mt is estimated from the combined mining of all three seams, resulting in 82.1Mt of product after washing. The production summary for the mine is appended below.

Mine Production and Dilution Summary



The majority of operating costs were developed from a "first principals" basis building up from the mine schedule and from the predicted advance / retreat rates. The model is based on a mine workforce of 263 personnel consisting of 204 underground shift workers and 59 support staff including 19 CHPP personnel. A summary of the operating cost model developed is appended in the table below.

Operating Cost Summary

Summarised Operating Costs		
Development	$/Dev m	2232.43
Longwall	$/LW t	8.27
Overheads	$/ROM t	8.48
Mining Cost	**$/ROM t**	**21.15**
Washing Cost	$/ROM t	3.42
Total Cost	**$/ROM t**	**24.28**
TOTAL COST*	**$/Prod t**	**32.47**

*Delivered to Truck Haulage Stockpile

Capital costs for the Boggabri underground have been determined for an underground mine using longwall top coal caving, with two development units and all supporting ancillary equipment, vehicles, machinery and office infrastructure. The total estimated cost of the project to the operational phase is $A787.6 million (excluding GST and escalation). A summary of the capital cost by major expense area is appended below.

Itemised Capital Breakdown

Description	Capital Expenditure A$
Feasibility and Exploration	15,000,000
Portal	1,542,543
Heading Development	2,159,561
Pre LW production capitalisation	42,000,000
Ventilation	6,687,500
UG Ancillary Equipment and Support Vehicles	15,488,677
UG Conveyors	88,060,000
Development Equipment	29,878,438
Longwall Equipment	149,000,000
UG Services	12,174,466
Mine Consumables	617,017
Underground ROM & Surface coal Handling	22,022,000
Conveying Overland	23,500,000
Power Supply and Distribution	16,166,864
Water and Waste System Reticulation & Equipment	15,085,087
Industrial Area and CHPP	49,618,469
Control and Communications Systems	3,552,181

Haul and Site Roads	7,268,149
Mobile Equipment	6,428,343
Contractor Indirect	6,170,173
Spares and First Fills	10,797,803
Commercial - Insurance / Legal / Gov and Fees	11,130,000
Maintenance Management	1,831,770
Project Management	23,145,862
EPCM	69,932,591
Contingency @25%	157,314,374
TOTAL	**786,571,868**

Health, Safety, Environment and Community

While the footprint and landform disturbance from underground mining will be significantly less than that of the proposed long term opencut, the impacts to the environment and community still need to be assessed.

The study identifies two key areas for ongoing research. The first is the likely effect of subsidence from longwall mining on local surface drainage, groundwater, and flora. The multiseam and varied seam thickness nature of the deposit, together with the massive conglomerate strata, is likely to result in large variances in the degree of subsidence from location to location. Dieback of large trees should be expected in these convergent zones where maximum subsidence is predicted.

The second major area of impact will be that of draw down of the natural water table. The impact of seam dewatering on the environment and on local community and farmers would need considerable more work particularly if the underground mine's inherent water-make is insufficient to supply the proposed wash plant, and external water from the Namoi River is required to supplement site requirements.

Risk

A broad level risk assessment was conducted to identify the most significant risks an underground operation at Boggabri would be likely to encounter from a combined; financial, environmental and operational perspective. After application of theoretical controls and re-ranking; one extreme residual risk and seven high level residual risks were identified.

The extreme risk was identified as being the cost impact from a future tax on gaseous emissions. This likely federal government legislation will add millions of dollars to operational costs with no controls available. This is an unavoidable risk and will impact both open cut and underground operations.

The residual high risks in no particular order were; spontaneous combustion, inrush due to multi seam mining, wind blast due to longwall goaf falls, sterilisation of resources due to multiseam nature of deposit, the interference caused to underground development during transition from opencut mining, the inability to maintain water supply to the wash plant and delays caused by the environmental approval process.

Ongoing Work

The study has identified that the utilisation of underground mining methods can be economically viable in the Boggabri resource. It may not however provide the greatest recovery of resources at the lower seam depths where open cut methods can recover a significant portion of the coal including the thinner seams that are not viable for underground mining. The resource contains deeper resources where underground mining methodologies could be applied and this can considered for future operations.

Specific areas where further work needs to be done are the geotechnical environment and subsidence impacts, groundwater behaviour due to underground mining, ventilation systems and optimisation of the mine design.

Boggabri Coal UG Mine Study

TABLE OF CONTENTS

5.0 MINE INFRASTRUCTURE AND FACILITIES

6.0 COAL PROCESSING and HANDLING

Consulting

Consulting

1.0 INTRODUCTION

1.1 Background

As part of the Environmental Approval (EA) process, Boggabri Coal needs to show they have considered the application of underground mining techniques in the target area of Boggabri mining lease. WDS Consulting has been engaged to undertake a concept study of underground mining in the area targeted under the current EA application process.

1.2 Project Description

Boggabri open cut coal mine is located north-west of Tamworth in the Gunnedah Coalfield, about 15 km north-east of the township of Boggabri, New South Wales. Idemitsu Boggabri Coal Pty. Ltd. owns 100% rights of the coal mine through its subsidiary Boggabri Coal Pty. Ltd (Figures 1.1 and 1.2).

Boggabri Coal is currently in the process of submitting an application for an EA to extend the Mining Area shown in the Figure 1.3 below. The figure identifies the current lease boundaries. The area under consideration for this evaluation is the extension to the existing open cut mining operations (Figure 1.4). The area contains multiple seams of economic significance. The objective of this study is to develop a conceptual design and evaluation of the recovery of the targeted resource area by underground mining methods. Future and deeper underground mining areas are not considered as part of this evaluation.

There are 8 seam groups in total which can be mined using open cut methods (Figure 1.5). For underground mining only 3 in the target area were identified as having potential for underground methods; namely the Braymont, Jeralong and Merriown. Figure 1.6 shows an East-West sectional representation of the targeted seams. The other seams have not been considered in this study due to a combination of; low seam thickness below that economically recoverable with current mining technology, and lack of physical area limited by the line of oxidation and the location of the lease boundary.

Table 1.1 Target Seams

Coal Seam	Average Thickness (m)	Tonnage (Mt)
Braymont	4.9	75
Jeralong	2.5	47
Merriown	2.2	46.5

The mine commenced open cut production in late 2006. It currently is producing up to 1.5 Mtpa of semi-soft coking and thermal coal and plans to increase the output to 4.3 Mtpa by 2013. Currently mining activity is going on in two pits:

- Jeralong pit to the north which is mining the Merriown, Jeralong and Bollol Creek seams and advancing to the east northeast.
- Merriown pit to the south which is mining the Merriown seam and advancing to the north.

1.3 Scope of Study

Appendix 1 details the study scope requirements for various different levels of estimate accuracy. For this report we are completing the work required to provide a Conceptual Study with an estimate value of +/- 30%.

The study will review the site and resource data available at the time of completing the study. Mining systems and options will be developed to identify a viable design to maximise the recovery of the resources. Equipment and infrastructure requirements will be identified to support the operations. The coal quality review will identify treatment requirements. Operational and development requirements will be identified to ensure a comprehensive evaluation can be completed within the study measures.

The design will be evaluated through modeling to determine the capital and operating cost requirements. The cost inputs have been sourced from WDS Consulting's database which is based on similar actual projects either recently completed or currently in the approval process. Environmental and community impacts of underground mining have been assessed. The project was subject to a risk assessment process to identify issues for further study or provisions to be made at this level of study. The final report has been subject to both internal and client review.

1.4 Reference Data

TITLE	AUTHOR	PREPARED FOR	DATE
Single Unit Mine Feasibility Study	Unknown	Boggabri Coal Development, BHP Collieries	October, 1979
2 Mtpa Underground Mine Plan to supplement the 4.5 Mtpa Truck and Shovel with Draglines Study	J. Hempenstall,	Boggabri Project, BHP Coal	May, 1981
Prefeasibility Study for Development of an Underground Mine	Unknown	AMAX - BHP Joint Venture	May, 1977
Boggabri Underground Assessment	BUCL Technical Services	BHP – UTAH Minerals International	February, 1990
Underground Mining Plan, Feasibility Study	BHP Northern Collieries	Boggabri Coal Development, AMAX – BHP Joint Venture	September, 1979
Geotechnical Site Visit Report PSM1227.R1	PSM Pty Ltd	Boggabri Operations, Idemitsu Australia Resources Pty Ltd	April, 2008
Supplementary Underground Mine Plan : G3/9 - F	RL McKinnon BHP Control Engineering Division	AMAX Iron Ore Corporation, Coal Division	September, 1981
Notes on Revised Mine Plan			Feb, 1990 or later
Section 5.2 Geotechnical Assessment	Coffee Partners	BHP Engineering	Mid 1980's
Boggabri Coal Project Mathematical Modelling of Auger Mining in the Merriown Seam	G.E. Holt &Associates	Muswellbrook Coal Company Ltd	December 1993
Quality Evaluation of Boggabri Coal (Spon Com Reference)	Unknown	Unknown	Circa 1995
Boggabri Project, Geological Report	Muswellbrook Coal Co Ltd	Idemitsu Boggabri Coal Pty Ltd	October 1992

2.0 RESOURCES

2.1 Tenure

In late 1991, Idemitsu Boggabri Coal Pty Ltd became the sole owners of the Boggabri Coal Project. It is located approximately 15km north east of the town of Boggabri and approximately 300km northwest of Newcastle in the Gunnedah Basin, Northern New South Wales, see Figures 1.1 and 1.2.

2.2 Exploration History

The Exploration Permit Tender Area #1 (EPTA) was granted to the Joint Venture participants in December 1975. This covered an area of 260 km^2, as seen in Figure 2.2. Drilling commenced in January 1976 with a 20 hole program. This program indicated that the most prospective section of the EPTA was the northwest corner. Over the next two years (to 1978), exploration continued in what is now ML368. In 1979 a Mining Lease Application (MLA) was made over the now current lease boundary (refer Figure 1.3 & Drawing 3.1) so to gain secure tenure over the coal resources. A355 to the immediate west of the CL368 was granted in 1985 and A339 to the immediate east was granted in 1986. CL368 is due to expire in November 2011.

Drilling has been undertaken on the Boggabri Lease since 1976. 397 boreholes had been drilled prior to 1992 for a total of 38,235m of drilling. Since 1992, Idemitsu have drilled 111 boreholes with the aim of infilling gaps in data and raising the confidence level of the geological interpretation. In total, 449 boreholes have been drilled over CL368 and A355 (413 in CL368, 36 in A355) and nine have been drilled in A339 (refer Figure 2.3).

Downhole geophysics have been run in all boreholes with the exception of the LOX line holes. The geophysical suite consists of:

- Coal combination sonde (dual density, natural gamma and calliper)
- Resistivity
- Neutron
- Sonic in selected geotechnical boreholes.

Other geophysical surveys that have been run are:

- Ground resistivity
- Magnetometer

- Electromagnetic sounding
- Minisosie seismic. This trial was run to test the suitability of this technique for seismic acquisition over the mining lease. It proved to be unworkable in the project area using 1992 technology.

All of the early trialed geophysical surveys have failed to produce useful data, most likely due to the relatively deep weathering profile (15m – 75m) and the thick, hard conglomerates in the area which were been sourced from the nearby basalts. This means there is a lack of contrast in results in the surveys making differentiation of rock types difficult. Coal seam gas exploration is currently being undertaken in and around the Boggabri area using Minisosie seismic acquisition. This suggests advances in acquisition and processing technologies have possibly matured sufficiently to accurately image coal seams in the area. This should be further considered in subsequent exploration for underground resources.

The current opencut areas of CL368 have relatively tight borehole spacing, as seen in Figure 2.3. Over the potential underground mining area, the borehole spacing is approximately 400 meters between holes, which may be too great to give the high levels of confidence required for the geological interpretation of the potential underground operation. Further exploration will be required to support underground operations including a further review of the application of seismic techniques. While seismic surveys were identified as not being successful in earlier work, recent improvements and development of the technique should be explored. A sustained drilling program will be required to increase the confidence level for sustainable underground mining operations. This is supported by the number of modelling artefacts (bull's eyes) apparent in the seam floor RL maps (Drawing 4.5 Braymont; Drawing 4.10 Jeralong; Drawing 4.16 Merriown).

Given the structural history of the area, significant faulting is unlikely and no major faults (greater than seam height) have been identified to date. There has been some local seam variations such as washouts, seam thinning and splits identified. Further drilling would be very useful to determine the true nature of these structures.

2.3 Current Operations

The Boggabri Coal Project is a contract mine operation with open cut mining services provided by Downer EDI Mining. At present the mine produces 1.5 MT per year (ROM) of low ash thermal coal from two pits, the Jeralong pit to the north and the Merriown Pit to the south. Mining of the coal is facilitated by overburden removal operations that move 14 million BCM of spoil annually by truck and shovel operations. The mined seams vary in thickness from less than one metre to in excess of two metres. The coal is transported by truck to the crushing plant for crushing to the correct size. It is then transported by rail to

Newcastle for export. The open cut mining operations are contracted through to 2011. This provides the interface for the establishment of underground mining operations. This has been the assumption made for the concept study.

2.4 Resource Setting

The project area is part of the Maules Creek Sub-basin which is part of the larger Sydney – Gunnedah Basin. The Maules Creek Sub-basin is separated from the other component of the Gunnedah Basin, the Mullaley Sub-basin, by the Boggabri Ridge to the west. The Boggabri Ridge is an anticlinal ridge/basement high of Lower Permian age volcanic rocks that trend approximately north – south and divide the Gunnedah Basin. These volcanic rocks form the basement of the Gunnedah Basin. The sedimentary rocks of the Maules Creek Sub-basin overlap onto the Boggabri Ridge and are truncated by the Hunter – Mooki thrust fault, approximately 17km east of the Boggabri Coal Project. This thrust fault is believed to have commenced movement during the mid Permian and continued until the upper Triassic. The structure dips approximately 25^{o} towards the east, trending north-south. As a result, much of the Maules Creek Sub-basin has been thrust under the New England Fold Belt.

The coal bearing Nandewar Group consists of the Leard Formation and the Maules Creek Formation (see Figure 2.1). The Leard Formation conformably overlies the Boggabri Volcanics and consists of dark grey to black kaolinitic sedimentary rocks. There are coal bearing horizons within this unit, however they tend to be high ash and not economic targets. The unit ranges in thickness from a few centimetres to in excess of 10 metres in the deeper, thicker parts of the sub-basin.

The Maules Creek Formation conformably overlies the Leard Formation. This unit is also coal bearing and is made up of lithic conglomerates (clasts sourced from the Boggabri Volcanics), sandstones, siltstones, mudstones and coals. This unit hosts the coal measures that can mined at the Boggabri Coal Project. The contact between the Leard Formation and the Maules Creek Formation is gradational, except in the northern section of the sub-basin where a fine grained lithic unit developed between the Leard Formation and the Maules Creek Formation. This unit is named the Goonbri Formation and consists of interbedded fine grained sandstones and siltstones. In the Boggabri Coal Project Area, the Maules Creek Formation is up to 500 metres thick.

The stratigraphic relationships in Gunnedah Basin are demonstrated in Figure 2.1.

The depositional environment of the Maule Creek formation ranges from alluvial fans near the Boggabri Ridge to braided streams to the east. The optimal environments for coal seam deposition were near the Boggabri Ridge. The thick, low ash coal seams were deposited here. Further from the Boggabri Ridge conditions were less conducive to coal deposition, resulting in thinner seams with greater splitting. Seam splitting in the Maules Creek Formation was controlled predominantly by fluvial channel migration.

The seams of interest in the Boggabri Coal Project are hosted in the Maules Creek Formation. The three seams of interest to the potential underground project are (in descending stratigraphic order):

- Braymont
- Jeralong
- Merriown

The seam splitting nomenclature is defined in Table 2.1

Table 2.1 Seam Splitting Nomenclature

<table>
<tr><th>Main Seam Name</th><th>Main Seam</th><th>Split Level 1</th><th>Split Level 2</th><th>Split Level 3</th><th>Split Level 4</th></tr>
<tr><td>Braymont Upper</td><td>BRU</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Braymont BR11</td><td>BR11</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Braymont BR12</td><td>BR12</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Braymont</td><td rowspan="6">BR</td><td rowspan="4">BRA</td><td>BR13</td><td></td><td></td></tr>
<tr><td rowspan="3">BR2</td><td>BR21</td><td></td></tr>
<tr><td rowspan="2">BR2B</td><td>BR22</td></tr>
<tr><td>BR23</td></tr>
<tr><td rowspan="2">BR3</td><td>BR31</td><td></td><td></td></tr>
<tr><td>BR32</td><td></td><td></td></tr>
<tr><td>Jeralong Upper</td><td>JEU</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Jeralong</td><td rowspan="4">JE</td><td rowspan="2">JE1</td><td>JE11</td><td></td><td></td></tr>
<tr><td>JE12</td><td></td><td></td></tr>
<tr><td rowspan="2">JE2</td><td>JE21</td><td></td><td></td></tr>
<tr><td>JE22</td><td></td><td></td></tr>
<tr><td>Merriown Upper</td><td>MNU</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Merriown</td><td rowspan="4">MN</td><td rowspan="2">MN1</td><td>MN11</td><td></td><td></td></tr>
<tr><td>MN12</td><td></td><td></td></tr>
<tr><td rowspan="2">MN2</td><td>MN21</td><td></td><td></td></tr>
<tr><td>MN22</td><td></td><td></td></tr>
</table>

Braymont:

This unit is the best developed unit in the Sub-basin and is therefore the major target seam. As it is the highest stratigraphically, it has been scheduled to be mined first. The seam is fully coalesced only in a relatively limited area of the far northwest of the mining area. The maximum recorded thickness of the Braymont seam is 7.6 metres in the northwest section of CL368. To the south and east of this area, the BRU ply has split from the top of the Braymont seam. Towards the east of CL368, the BR ply has split further, into the BRA and BR3 plies, as seen in Table 2.1. The average thickness of the Braymont seam is 4.9 metres.

Jeralong:

The Jeralong Coal Seam is relatively well developed over most of the Project area. It is slightly thinner in A355. The maximum recorded thickness of the seam was 4 meters. The average thickness of the seam is 2.45 meters. Towards the south east of CL368 a split in the Jeralong Seam has developed. The plies have been named JE1 and JE2 and have average thicknesses of 1.1 meters and 1.2 metres respectively. The split is generally thin. Towards the southeast of CL368 another basal split has developed, splitting JE2 into JE21 (upper) and JE22, see Table 2.2. The average thickness of JE21 is 0.55 meters. The interburden thickness between the Jeralong seam and the overlying Braymont seam is relatively consistent over the project area, except in the northeast and east where it is thicker.

Merriown:

The seam is developed reasonably consistently across the project area, averaging 2.22 metres thickness. A split developed in the northeast corner of CL368. Here the plies have been named MN1 (top) and MN2 (base), see Table 2.2. The average thicknesses of the plies are 0.72 metres and 0.59 metres respectively. The thickness of the split is generally less than 1 metre, although is in excess of 7 metres in the northeast part of CL368. A further split has developed in the upper ply in the east of CL368. The upper ply has been designated MNU. The split is up to 7 metres thick, although it is generally approximately 1 meter thick. In the southwest of A355 and the southeast of CL368 the Merriown has coalesced with the overlying Jeralong seam. Generally the interburden between these two seams varies across the area and the proximity of the seams needs to be addressed in the mine design. The average thickness of the Merriown seam is given as 2.2 metres.

Gas:

There are very few mentions of gas testing in the older geological reports. This, in conjunction with the low water table (which would have assisted in degassing the seams) would make it seem fairly likely that the levels of gas in the coal measures are relatively low. It would be prudent however to obtain a number of gas desorption samples so gas content can be quantitatively determined. Similarly, there are few mentions of ground water studies in the older geological reports.

2.5 Geological Structure

Structural features in the area are dominated by the Hunter-Mooki Fault to the east. This is a major regional thrust fault. This structure is believed to have been active from the Lower Permian to the Mid Triassic as part of the Hunter-Bowen Orogeny. Faulting is rarely observed in the lease, despite the proximity to the Hunter – Mooki Fault. Minor faulting has been observed in drill core.

The seam floor RL maps for the three seams of interest (Figure 4.5 Braymont; Figure 4.10 Jeralong; Figure 4.16 Merriown) show that the seams generally dip at approximately 1^{o} to 2^{o} towards the northeast, although there are localized areas where dips are steeper, up to 6^{o}. It is unsure at present what exactly controls these structures but they are not thought to represent faulting.

The primary control on the shape and structure of the sedimentary infill within the Boggabri Coal Project lease area was the paleotopography of the Boggabri Volcanic Basement and the (generally) high energy depositional environment. Figure 1.6 shows the cross section across the lease from east to west and illustrates the basement topography as a broadly northeast dipping structure. The alluvial fans were deposited on this paleotopography and the conglomerates were sourced from the Boggabri Ridge. The subsidence along these structures was irregular, creating both high energy depositional environments under which the conglomerates were deposited and quiescent, slowly subsiding environments that allowed the thick peat accumulations over the fan systems.

The lack of faulting within the A355 and CL368 leases appears to be due to a major fault to the east of CL368, the Goonbri Creek Fault, a north north east trending, steeply dipping structure. The strata immediately adjacent to this structure dip at between 60^{o} to 70^{o} east south east. It appears that this structure was the primary mechanism of stress release in this area, protecting the rocks in the Boggabri lease from the major compressional disturbances associated with the Hunter-Mooki Fault. The common appearance of slickensides in the basal seam of the Maules Creek seam (the Templemore seam) indicates this coal seam acted as a glide plain for the sedimentary sequence, releasing most of the strain in the area.

The base of weathering varies from 15m to 70m below surface. The weathering base is generally strata controlled with the coarse siliciclastic sedimentary rocks being more susceptible to weathering than the mudstones.

2.6 Coal Quality

The 3 seams that have been targeted as possible underground resources comprise of bituminous coals of high energy with low ash and sulphur contents. The seams vary in thickness within the proposed mining area with the Braymont seam averaging approximately 4.9m, the Jeralong 2.5m, and the Merriown 2.2m. The Braymont seam contains a parting of up to 0.8m within the proposed mining area. The high levels of organics in the coal may lead to spontaneous combustion issues and the amount of small coal less than 2mm may affect handling characteristics all of which must be considered further should the project develop further. The coal is not likely to be suitable as a coking coal however it may be useful as a PCI coal given its low ash / high energy characteristics. Care will need to be taken with the un-burnt carbon content. Table 2.2 outlines an analysis of the separated and raw coal.

Table 2.2 Raw Coal Analysis

Analysis of Boggabri Coal	*Coal*		*'93 Boggabri*	*Merriown*	*Jeralong*	*Braymont*
Total Moisture	%	AR	10.8	8.2	8.2	8.1
Calorific Value	kcal/kg	AD	7,030	7,370	7,320	7,290
HGI		AD	49	47	47	49
Proximate Analysis						
Moisture	%	AD	5.70	4.80	4.80	5.10
Ash	%	AD	7.30	5.00	5.10	5.20
Volatile Matter	%	AD	33.60	35.80	35.10	36.60
Fixed Carbon	%	AD	53.40	54.40	55.00	53.10
Ultimate Analysis						
Carbon	%	DAF	83.31	82.90	83.09	82.61
Hydrogen	%	DAF	5.08	5.50	5.23	5.56
Nitrogen	%	DAF	1.84	1.79	1.83	1.90
Nitrogen	%	DB	1.71	1.70	1.74	1.80
Oxygen	%	DAF	9.34	9.43	9.52	9.55
combustible Sulphur	%	DAF	0.42	0.38	0.33	0.38
Total Sulphur	%	DB	0.44	0.36	0.32	0.36
Chorine	ppm	DB	310	29	51	160
Fluorine	ppm	DB	63	25	23	18
Fuel Ratio	-		1.59	1.52	1.57	1.45
CSN	-	AD	1.00	3.50	2.50	3.00
Ash Fusibility	Deg C					
IDT (Oxidised)	Deg C		1,370	1,480	>1500	1,470

Cont…. **Analysis of Boggabri Coal**	*Coal*		*'93 Boggabri*	*Merriown*	*Jeralong*	*Braymont*
HT (Oxidised)	Deg C		>1500	>1500	>1500	>1500
FT (Oxidised)	Deg C		>1500	>1500	>1500	>1500
IDT (Reduced)	Deg C		1,320	>1500	>1500	>1500
HT (Reduced)	Deg C		>1500	>1500	>1500	>1500
FT (Reduced)	Deg C		>1500	>1500	>1500	>1500
Ash Composition						
SiO3	%		64.94	80.89	75.45	69.77
Al2O3	%		21.17	15.48	19.66	25.91
TiO2	%		1.10	0.98	1.14	1.32
Fe2O3	%		4.03	1.37	1.16	1.26
CaO	%		3.05	0.09	0.14	0.1
MgO	%		0.46	0.18	0.28	0.19
Na2O	%		0.35	0.28	0.45	0.2
K2O	%		0.99	0.53	0.97	0.34
P2O5	%		0.11	<0.05	0.05	0.12
MnO	%		<0.05	<0.05	<0.05	<0.05
V2O5	%		<0.05	<0.05	<0.05	<0.05
SO3	%		1.64	0.02	0.05	0.02
Size Distribution						
~50mm	%	AD	0.0	0.0	0.0	0.0
~25mm	%	AD	8.1	41.0	42.6	31.1
~15mm	%	AD	12.2	21.2	23.9	24.7
~10mm	%	AD	16.1	11.9	14.3	12.6
~5mm	%	AD	18.4	9.9	11.9	12.3
~2mm	%	AD	19.9	7.9	8.0	10.7
~1mm	%	AD	10.6	3.6	4.2	3.6
~0.5mm	%	AD	3.5	2.3	2.3	2.5
~0.25mm	%	AD	3.4	1.1	1.4	1.4
0.25mm~	%	AD	2.6	1.1	1.4	1.1
2mm~	%	AD	25.1	8.1	9.3	8.6

2.7 Geotechnical

2.7.1 Design Parameters

STRUCTURE:

Rocks in the area are dominated by the massive conglomerates. The fine grained units, the siltstones and mudstones are associated with the coals and have well developed laminations. The immediate roof of all the upper coal seams addressed in this report is composed of relatively competent coarse ground sediments including coarse pebbly sandstones and conglomerate. This competent roof is expected to provide good roof conditions for underground mining. It will also necessitate parameters to ensure efficient caving during secondary extraction.

The immediate coal seam material is generally weak, fine grained and thinly laminated. Dispersive clay properties have been identified in this material. This will result in poor trafficability conditions for the underground mine.

Jointing, especially in the conglomerates is relatively rare with inter joint spacing in the conglomerates being up to 12m. Slickensides are rare, but are found in all boreholes. They only occur the fine grained units and above the coal seams, indicating that the conglomerates are resistant to deformation and they concentrate stress into the weaker, laminated units.

SLAKING:

The slaking potential of rocks in coal measures is usually high given the presence of hydrophilic clays. Slake tests were undertaken on core samples and the summarized results are given in Table 2.3

Table 2.3: Waste Material Classification

Rock Type	Classification Result (%)				
	Low		Medium		High
Conglomerate	88	4	8	-	-
Sandstone	38	17	17	-	26
Siltstone	12	12	44	12	20
Mudstone	12	22	22	22	22

As can be seen, the rocks immediately proximal to the coal seams, the siltstones and mudstones, have the highest slaking potential.

2.8 Surface Features

2.8.1 Topography:

As seen in Drawing 3.1, the topography of the mining lease is dominated by a ridgeline that wraps around the three leases from A339 in the east, to the north of CL368 and along the north western boundary of A355. The topography changes in height from a minimum of 270m above sea level in the southwest corner of CL368 to a maximum of 460m above sea level along the western boundary of A355.

2.8.2 Land Use:

The Boggabri Coal Project is located in the Leard State Forrest. The land surrounding the mining lease is predominantly used for seasonal cropping and raising of beef cattle.

The current open cut mining area is located more than five kilometres from the nearest farms. The proposed underground operations would be a minimum of four kilometres from the nearest farms.

Access to the Boggabri mine site has recently been sealed from the previous all weather gravel road.

2.9 Facilities and Infrastructure

The underground mine will utilise as much of the existing site access and facilities as possible. Additional facilities will be contained predominately within the area already allocated for open cut disturbance. Areas for additional mine and services access and for the main ventilation shaft and other surface support facilities have been identified in this report.

3.0 MINE LAYOUT

The mine layout for the Boggabri underground concept study entailed an interactive approach taking into consideration;

- the over-riding physical constraints,
- mining method options,
- the multi-seam nature of the deposit,
- the geological and geotechnical parameters known about the coal seams and surrounding strata,
- mine access options (taking into consideration the projected 2011 opencut face positions), and
- other identified mining hazards that either have been identified or should be considered at this level of study.

3.1 Lease Area and Idemitsu Design Constraints

The first stage of the mine layout design process was to identify the mining area physically available for underground mining including the nominal constraints as defined by Idemitsu. These nominal constraints were required to keep the underground design in direct equivalence with the proposed opencut, so that the two options could be compared from a perspective of design impacts, environmental and community impacts, resource recovery and cost.

The main overriding constraint was the mining lease area boundary. The Boggabri operations area is complicated by consisting of three adjoining leases, two of which have been granted with full surface rights (A355, CL368), the third of which does not have surface rights (A339). In order to maintain direct comparison with a proposed opencut design across the same area, Idemitsu directed that the underground design exclude the A339 lease which does not allow for opencut surface disturbance. For the study a 50m inset boundary was drawn around the combined CL368 and A355 leases as a statutory limitation as shown on Drawing 3.1.

The second constraint set by Idemitsu was to review only those coal seams within the long term opencut projection. These included eight seams from the upper lying Herndale down to the lower lying Merriown, which at its deepest exposure will require open cut excavation of approximately 170m of overburden (refer Figure 1.6). This constraint excluded seven deeper additional coal seams from the study including the Tarrawonga and Templemore seams which have been earmarked by Idemitsu as having potential for long term underground mining.

The third constraint was the projection of the opencut design to 2011 as being the transition point from the existing opencut to a potential underground operation. The open cut design included a projection for the spoil dump trailing behind the opencut and consuming both mined out and virgin surface terrain.

3.2 Mineable Coal Thickness and LOX Lines

The second stage entailed a broad review of all coal seams within the targeted lease area and vertical horizon (at or above the Merriown seam level). This broad review was specifically looking at the coal thickness and line of oxidation for each seam that, along with the lease boundary, would provide a physical limitation to mining

This broad review quickly removed the Thornfield and Bollol Creek seams from consideration as being less then a requisite minimum 1.5m seam thickness for possible underground mining.

The Herndale, Onavale and Teston seams, while having acceptable coal thickness, were excluded for not having sufficient plan area between their respective LOX lines and the lease boundaries to warrant the cost of underground development (refer Drawing 3.2).

Out of the eight potential seams only three; the Braymont, Jeralong and Merriown were considered for the conceptual underground mine as having both acceptable thickness and sufficient reserve area to warrant the cost of underground access and development.

3.3 Methodology Identification

Having established three target coal seams, and the limits to which mining would be available, the next stage was to review methods of underground mining that could be deployed. The main criteria applied for method selection was resource recovery, closely followed by safety, productivity and existing industry experience base. Given the relative short time frame in which to complete the study, a shortlist of methods was identified by WDS Consulting. The short listed methods were then converted to draft designs for the upper Braymont seam to determine a single methodology to be applied throughout the lower seams and to be carried forward into more detailed planning and financial analysis.

Three methodologies were identified as warranting of more detailed investigation namely; Longwall, Place Change and Wongawilli. The longwall method of mining was identified early as the most probable standout. This was based on its likelihood of having;

- the highest reserve recovery,
- its application being the most common method of underground coal mining used in Australia today,
- its high and consistent production rates, and
- its inherent safety.

The main downside to longwall mining being the large capital cost to establish and the significant development lead time required before the first longwall coal could be completed and start producing economic coal tonnages.

Place Change and Wongawilli Bord and Pillar methods were viewed as potential challengers on the basis that the nature of the deposit and lease boundary shape could make it difficult to design a uniform and consistent longwall block layout. The flexibility of Bord and Pillar design could potentially overtake longwall recovery by enabling panels to be laid out into more of the available spaces.

The Place Change method of mining is based on highly productive first working development by Continuous Miner (CM). The method is based on mine layouts with multiple headings and small pillars. The small pillars improve resource recovery and allow for short distances for movement (flitting) of the CM between working faces to maximise cutting time. The method separates the bolting and cutting phases of mining by utilising a specialised bolting machine for installation of ground support. In this fashion production from the CM is not delayed waiting for ground support installation. Other than the time lost flitting the CM from one mining face to the next, the method produces at a consistent and steady rate. Shuttle cars transport the coal from the CM to the conveyor loading point (boot end). Overall productivity is generally much less then can be achieved by longwall methods.

The small pillars in the Place Change method have a major impact on first working efficiencies, productivity and resource recovery. While small pillars improve recovery of first working, their size is generally not amenable to secondary extraction other then by minor pocketing of the pillars on retreat after first working. The majority of the pillar area created by the Place Change design is sterilised from future resource recovery.

The Place Change method of mining is common place in both South Africa and the United States. It is not as common in Australia but has been and is used at several mines both in Queensland and New South Wales. As the method does not deploy caving techniques, it is not considered to be a high safety risk to personnel. Finding and or training people to deploy the method would not be considered a high risk as the basic CM technology is standard though out the mining industry.

Wongawilli is a high recovery method of mining based on large pillar sizes with up to four roadway headings. The pillars are designed large to enable their splitting and secondary extraction on retreat after the panel has been fully developed on first working. The method takes its name specifically from a system of driving extended roadways (splits) off one edge of the panel as part of the retreat. These splits up to 100m long are driven in close proximity to each other in such fashion that the intervening solid pillar (fender) between the splits is also extracted after each split is driven. The combination of first working and then secondary extraction of the first working pillars and the additional coal from the side split roadways and recovery of the fenders, gives the method excellent overall coal recovery potential.

The major downside of the method is its safety risk. While the use of mechanised Breaker Line Supports (BLS) have provided a level of protection to personnel and equipment, the inherent nature of being in close proximity to open workings in the process of caving makes the method inherently more dangerous to personnel with increased risk of loss of equipment through burial than other methods.

Another negative of the Wongawilli method is the highly cyclic nature of the production cycle which alternates between slow first working development and then more rapid secondary extraction phase. The secondary extraction cycle is highly variable in itself as it swaps between the slow pillar and Wongawilli split driveage, followed by rapid and highly productive recovery of fenders. Significant halts to production can be a risk as a result of uncontrolled roof falls and equipment burials requiring recovery.

Pillar extraction techniques by continuous miner are still relatively common in the United States but are virtually non existent in South Africa. In Australia while once common, are no longer used at any minesite in Queensland but still have limited use in New South Wales. The highly specialised nature of the method could make the establishment of an acceptably skilled workforce challenging.

3.4 Mine Access

Three options for underground mine access were reviewed, the first being the establishment of an independent opencut boxcut to the respective seam levels, the second the construction of drifts, and the third utilisation of the existing open cut highwall. The construction of an independent boxcut or drifts would have the same advantages and problems compared to the opencut highwall option and are discussed together below.

Access to the underground reserves by boxcut or drift could be made to the north-west of the projected opencut spoil dump area in close proximity to the Leard Forest Road. In this general zone, the depth of cover to the seams is relatively shallow being close to their respective LOX lines, ranging between 40m to 50m.

The major advantage of a separate boxcut or drift entry would be the separation between opencut and underground operations. The reality of a transition from one form of mining to the other would be a requirement for an overlap to ensure continuity of production as the open cut winds down and the underground operations ramp up. Having the two operations separated geographically would have significant benefit in minimising disruption during this overlap transition period.

There are however several major disadvantages of the boxcut or drift options that would need to be considered. The first is of course capital cost which while not expected to be excessive due to the relatively shallow depth, would be significant compared to the alternative highwall option which has virtually no upfront costs other then the provision of protective portal arches for each entry location.

At a standard 1:7 gradient, a single boxcut entry to coal at 45m depth of cover would require the excavation of approximately 400,000 bcm of material. Similarly a single drift would require around 315m of driveage.

An unfortunate nature of the seam arrangements at the Boggabri deposit is that the upper lying Braymont seam, which needs to be accessed first, lies within the confines of the underlying Jeralong seam. Similarly the Jeralong seam lies within the confines of the Merriown. This has an adverse effect on boxcut or drift design in that it results in each seam level having to have its own daylight penetrating boxcut(s) or drifts developed if reserve sterilization is to be avoided.

If a continuous boxcut or drift was developed through the Braymont to the lower seams, it would have to be established over mineable Jeralong and Merriown reserves making their recovery near impossible. A single continuous drift from the surface at 1:7 gradient, passing though all three seams would need to be approximately 1700m long. Such single drift would require the added complexity of allowing for the seam take off into the Braymont and Jeralong levels while allowing for the continuation of the drift into the lower levels. While possible it would add to the engineering complexity and cost particularly with the conveyor drift.

Another significant disadvantage of either the boxcut or drift options would be the requirement for additional disturbance of natural surface areas. Access to the underground by highwall can take advantage of disused land areas and benches already established by the open cut for offices and laydown areas. If access to the underground were to be established separate from the opencut, then these facilities as well as the boxcuts and or drifts would have to be established over virgin undisturbed land with an expected significant increase in land disturbance area.

For the concept study, detailed analysis of the cost for boxcut and or drift entry strategies flowing through into actual underground designs have not been made. It is a broad level assumption that the negatives for these options would be far out weighed by the benefits of the highwall access option. The detailed mine design for this study has therefore been confined to opencut highwall access only.

With regard to its only significant drawback, that being the interference caused during the transition from opencut to underground, it is assumed that this would have to be managed by scheduling and progression of the Braymont bench as early as possible to its final position. In this fashion, a start to underground mining could occur while the final opencut face positions on the Jeralong and Merriown levels are still being achieved.

Detail for the highwall access option is addressed in the following Mine Design section.

3.5 Mine Layout Orientation

The horizontal alignment of the mine headings and side panels was based on the only structural information available that the principal overburden joint direction is east – west. On the assumption that this is consistent through the coal measures, the design principal of roadways being aligned outside of an envelope between plus or minus 30° from this direction and the perpendicular north - south direction was used. This provided acceptable orientations between 30-60° and 120-150°.

Several mine layouts were developed within the design criteria. The layout that provided the highest resource recovery has the initial Mains aligned at 120° with access to the underground via the end side wall of the opencut bench. Side panels are then laid at a favourable 30°. The second Mains panel on each seam level could not avoid having a deleterious angle of 0° in order to maximise resource recovery. It is assumed that any geotechnical problems caused by this orientation will have to be overcome by adequate strata support. The side panels running off from the secondary Mains have however been angled back to within an acceptable alignment at 51°.

Drawing 3.3 shows the mine orientation rosette and the preferred alignment orientation for the Mains, sub Mains and side panels.

3.6 Multi Seam Strategies, Pillar Design

Research into multi-seam mining from Australian and overseas operations have indicated that; for relatively shallow deposits, mine pillars between levels should be kept as close as possible to vertical alignment to ensure stress distribution is maintained within the solid core of pillars through the levels. The proposed mine layout has adopted this as a main design fundamental with Mains and Development side panels kept in exact vertical alignment with pillars of identical dimension.

With the multi seam design, pillars have been designed conservatively on the worst depth of cover case to the lowest seam, the Merriown. While there would be opportunity to optimise these sizes, the reality is that even the worst case for the Merriown seam is relatively shallow. The majority of the Merriown seam lies within a depth of cover range of 60 – 150m with the top north eastern corner increasing to a maximum depth of cover of 260m.

With the requirement for panel and pillar superimposition, the pillar designs for the overlying Jeralong and Braymont seams have been conservatively designed with the same standard dimensions as the Merriown. This results in these pillars being over designed to what would be required if they were a stand alone mine.

3.7 Minimum Depth of Cover

A general mining cut off depth of cover of 40m was used for all seams. This is believed to be a relatively conservative value given the nature of the high strength conglomerate overburden expected. This had the affect of slightly reducing block lengths on all seam levels particular on the western blocks close to the LOX line.

An exception to this general rule was made in the Braymont seam where a significant area of reduced cover (down to 25m) exists along the axis of the north-south Main's and into the eastern side panels. This zone would require special consideration during mining operation. The nature of the high strength conglomerate roof with over designed pillar dimensions should not present an issue during the development phase but could well affect longwall or Wongawilli operation particularly for longwalls during the recovery phase of the affected blocks.

A detailed geotechnical review of this area is required which could result in a substantial sterilisation of longwall reserves if the take off positions for the affected blocks must be shortened for deeper cover. If a strict 40m depth of cover is applied for longwall blocks, then 2,463m of longwall reserve from the Braymont seam will be removed.

3.8 Minimum Seam Interburden

Research into the minimum acceptable mining separation between levels in a multi-seam operation has indicated a correlation exists between the ratio of depth of overburden to interburden. Ratio values of 7.0 or less are seen as desirable with values up to 16 tolerable although extreme conditions could be expected at this value. Other anecdotal evidence indicates that interburden separation as low as 7.5m is possible so long as the quality of interburden is good.

For the Boggabri deposit the interburden distance between the Jeralong and Braymont seams averages between 35 – 40m with some localised thinning to the south west along the 1.5m LOX line. This combined with overburden to interburden ratios at or below 7 does not present any significant reduction in reserves for the Jeralong seam.

For the Merriown seam the interburden distance to the Jeralong is significantly less ranging on average between 15-20m with a maximum distance of 25m. Thinning between the seams to the south west is more pronounced and does result in a reduction to potential mining areas where the seam interburden drops below 7.5m and the ratio of overburden to interburden exceeds 16. The expected moderate to high strength of the massive conglomerate roof between the Merriown and Jeralong seams would be amenable to mining down as low as 7.5m interburden.

Another important determinacy is the time period between mining of the upper and lower seams with the greater the intervening period the better to allow time for strata stabilisation to occur. For longwall operations a time frame of between 7.5 months up to 2 years is suggested. The nature of the mining layout and schedule for Boggabri would not make this likely to be a significant issue.

3.9 Mine Partings

Mine partings have the most significant affect on the Braymont seam where the A-3 Parting Line overlaps a significant portion of the available mining area to the eastern lease boundary. The thickness of the parting, up to the A339 boundary, is not large, with the parting ranging from 0 to 0.8m. As the parting sits below the 3.0m horizon, the option for this zone would be to mine through the parting and accept the reduced product recovery through the wash plant.

In addition to the A-3 split, an intrusion of the Braymont 2-13 parting extends through the initial Main's access and side panels on both east and west sides. The Br 2-13 split line is a division of the upper A-split. The strategy in this zone would be for both continuous miner and longwall operations to keep the parting in the “non-mined” roof horizon. Mining in this zone would thus be limited to the combined BR-2 and BR-3 seam splits with a combined thickness averaging an acceptable 2.5 – 3.5m.

In both the Jeralong and Merriown seams, the respective JE 1-2 and MN 1-2 seam splits only affect minor portions of any eastern side panels up to the A339 lease boundary. On both seam levels the parting could be mined out up to 0.8m with the wash plant addressing the higher dilution. On both seams where the parting becomes in excess of 0.8m, there is sufficient thickness (in excess of 2.0m) in the lower ply to enable mining to continue below the parting horizon leaving the parting in the roof.

3.10 Other Mining Hazards

3.10.1 Seam Gas and Outburst Propensity

Research of the information provided by Idemitsu has not indicated any likelihood of excessive seam gas content for the coal measures at or above the Merriown seam level. Provision for gas drainage has therefore not been allowed for in the concept study, nor has it required impact on the design of the ventilation system to provide additional dilution capacity.

The shallow nature of the deposit and the expected low gas content are not expected to therefore combine to produce conditions amenable to outburst. Provision for outburst conditions in terms of reduced productivity, pre drainage and drilling ahead of CM units has not been factored in this study.

3.10.2 Spontaneous Combustion

Spontaneous combustion is likely to be one of the major hazards for an underground operation at Boggabri. Results of test work completed in 1993 and 1995 had varying results with the later test work showing a greater propensity to spontaneous combustion than the earlier tests. The methodology used in the analysis in 1993 and 1995 was to measure the rate of temperature increase from 100°C to 200°C. While this is not a recognised standard made today, the results did include comparison with other mine sites, particularly Ensham, which can be used as a reference.

Ensham, from modern test work, is known to have a high propensity to spontaneous combustion. The 1993 test program from Merriown seam coal showed an almost identical trend line to that of Ensham with the coal sample reaching a temperature of 200°C in 94 minutes. The 1995 test program had coal samples from the Jeralong, Braymont and Merriown seams reaching 200°C in 58, 59 and 67 minutes respectively indicating that all the Boggabri target seams would have a propensity to spontaneous combustion greater then that of Ensham coal, with the Jeralong and Braymont seams having the highest propensity.

The expected high propensity to spontaneous combustion will have impact on the mine layout and in particular on the Braymont seam where the additional coal thickness will require special consideration particularly if coal is left behind in caved workings.

The spontaneous combustion potential will impact on method selection. It will severely compromise Wongawilli methods which rely on forced ventilation through abandoned and caved workings. The method, even under the best conditions, will result in remnant small pillars or “stooks” being left behind in abandoned workings (goafs). These stooks not only provide the fuel for spontaneous combustion but prevent full compaction of the caved areas providing pathways for oxygenation of the coal.

Place Change methods will have the lowest risk from a spontaneous combustion point of view as they will not result in the generation of caved workings and their multi heading design with multiple return roadways will help to keep ventilation pressures low.

Longwall methods will have a higher risk then Place Change however their total extraction ability (apart from roof coal in thick seams), and their rapid advance rates will help to mitigate this risk. Rapid advance rates ensure remnant coal is starved of oxygen by being compacted and left far behind in the goaf, before any incubation period can occur. While the method does allow for ventilation pathways through the goaf, these are passive and not forced pathways as occurs in the Wongawilli method.

The conservative over design of pillars done as a result of the multiseam mine layout will benefit the mine from a spontaneous combustion mitigation perspective. Larger pillars will help to maintain a solid core to resist the formation of cracks and pathways that could lead to ventilation leakage and oxygenation leading to sponcom. The mine layout design will need to ensure an adequate number of roadways with balance between intake and return to ensure that mine ventilation pressures are kept as low as possible.

3.10.3 Inrush and Groundwater Management

Detail on the expected hydrology of the Boggabri deposit was not found within the resource material. Anecdotal evidence that water disappears into exploration boreholes while drilling through coal seams, indicate the seams to be porous and relatively dry. The highly porous nature could result in seasonal effects with increased water make during high rainfall periods.

There are no surrounding abandoned underground workings that could provide source of stored water for inrush. Existing site surface water storages are also not expected be located within the extent of planned underground workings and will not provide a potential for inrush from that source.

The major hazard from inrush will come as a consequence of the multiseam design if water is allowed to accumulate in the abandoned Braymont and Jeralong seam workings prior to subsequent extractive mining on the immediate seams below. Provision for keeping access to all low points in the mine layout on these seam levels may have to be made if water is shown to accumulate. The variable dip of the deposit may require an additional bleeder road be driven around the eastern side panels to ensure long term access for water drainage is maintained. The seam dip of the western side panels should ensure free drainage back to the Mains where water can be removed at all times.

In the absence of qualifying data, the study has not made any significant design changes to cater for exceptional water make. It is an area that would require further investigation and may require changes to the mine layout. The requirement to maintain long term access to longwall blocks will have minimal impact as a redundant bleed roadway can be established with minimal extra driveage. The requirement to maintain access to the back end of completed Place Change or Wongawilli panels could result in significant additional driveage, cost and sterilisation of reserves.

3.10.4 Windblast and Respirable Dust

Windblast and Respirable Dust are both hazards with high potential at the Boggabri underground.

The combination of shallow depth of cover and high strength massive conglomerate roof will not make for ideal caving conditions. The mine is likely therefore to have an elevated risk from wind blast effects. The design of block widths for Longwall or Wongawilli panels will need to take this into consideration to ensure subcritical conditions are avoided.

The expected hard dry nature of the coal seams will be conducive to the generation of dust. This may have an affect on ventilation and roadway design as well as on operational requirements for water sprays on coal clearance systems and for stonedust application. Roadway dimensions will ideally need to be kept as large as possible to ensure air velocities are kept low while still delivering adequate quantity for dilution and general mine requirements.

3.10.5 Frictional Ignition

Incendive sparking between coal cutting equipment and the hard conglomerate roof structures at the Boggabri mine would not be unexpected. The predicted low gas regime will however help to mitigate the risk of frictional ignition. It is not believed that the hazard of frictional ignition would result in any significant changes to the mine layout design.

3.11 Mine Layout Design Guidelines

3.11.1 Longwall

The conceptual layout for the Longwall mine on the Braymont Seam is shown on Drawing 3.4. The basic design parameters used for the layout and reserve calculations included the following;

- Retreat longwall mining
- Development roadway width of 5.0m
- 6 Heading Development Mains at 35m centres (30m solid)
- Twin heading gateroads at 30m centres (25m solid)
- Main Heading cut throughs at 50m centres
- Gateroad Heading cut thoughs at 120m centres
- Longwall block width of 250m
- Minimum Longwall and Development cut height of 2.0m
- Maximum Development cut height of 3.3m
- Maximum Longwall first pass cut height of 3.5m
- Top coal caving deployed to recover reserves above 3.5m at 60% recovery.
- Minimum seam interburden of 7.5m
- Minimum seam overburden of 40m
- Partings to be mined through up to 0.8m thickness to maximise coal recovery

3.11.1.1 Longwall Options

Retreat longwall mining was chosen as the standard methodology employed both in Australia and overseas.

While advance longwall mining potentially has improved reserve recovery it is believed the nature of the conglomerate roof would mitigate this advantage. The other major benefit of advance mining is that it eliminates the requirement for positive development float. The overall productivity increase of retreat longwall mining however well and truly compensates for its dependence on development roadway float.

With no active system available to bench mark, and reduced overall productivity, the advance system of longwall mining excludes itself from consideration.

3.11.1.2 Pillar Design

With the expectant medium to high strength of the Boggabri coal measures, Mains pillar widths of 30m solid (35m centre to centre) and gate road pillar widths of 25m solid (30m centres) where chosen based on the expected depth of cover to the Merriown seam. With the requirement for panel and pillar superimposition, the pillar designs for the overlying

Jeralong and Braymont have adopted the same standard dimensions as the Merriown. The coal pillar dimensions are seen as adequate for mitigation of the effects of spontaneous combustion.

3.11.1.3 Roadway Width

Roadway width has been based on a conservative value of 5.0m. This can be considered at the low end of possible widths given the nature of the likely longwall and development infrastructure required to produce at 4 - 5 MT/annum. Improved knowledge of the expected geotechnical conditions could increase this width to 5.5m up to 6.0m particularly if extra width clearance is required and or if additional development reserves for optimal resource recovery is required.

The impact on longwall reserves by increasing roadway width would need to be considered although this should be minimal. It would be expected that overall coal reserves would increase rather then decrease by increasing the base roadway width. Increasing roadway width would have the additional benefit of reducing roadway air velocities thus mitigating the impact of airborne dust and spontaneous combustion potential and would need consideration for these measures alone.

3.11.1.4 Number of Mains and Gate Road Headings

For the Main heading design, 6 development roadways was viewed as optimal for long term ventilation efficiency, redundant transport access, mitigation of other mining hazards, and allowance for longwall block access on both the left and right hand sides of the Mains. Increasing the number of main heading roadways to 7 would be too conservative and excess to requirement.

A 5 heading roadway Mains' could be successfully established with extra design complexity to access both left and right hand sides. Reducing the number of headings to 4 or less would be inadequate for access on both left and right sides and would force mine ventilation pressures into an unacceptably high zone given the high potential for spontaneous combustion and respirable dust.

Dual heading gateroads with shared maingates / tailgates between adjacent blocks (the maingate travel road becomes the tailgate for the next block) was chosen as the standard design technique used in Australia for retreating Longwalls. The assumed absence of any significant gas make suits this methodology and maximises the recovery of reserves for a retreating longwall.

3.11.1.5 Mains and Gateroad Cut Through Centres

The Mains Development cut through centre distance was set at 55m (50m solid) on the basis of minimising the requirement for cut throughs and additional coal development. This enables the advance of Mains to be accelerated so it does not become a bottle neck for gateroad and future longwall production. The value of 50m is an average and would not actually be represented in the detailed mine design. It is an average between shorter pillar lengths where Gateroads project through into the Mains and longer distances adjacent to the longwall blocks themselves. The use of longer pillar sizes in the Mains also helps reduce the requirement for ventilation stoppings thus improving ventilation efficiency. If resource recovery is a premium requirement and production from the Main's was seen as a profitable operation by it self (usually they are not), then a smaller Main's pillar length could be considered to increase the recovery of coal.

A gateroad cut through centre distance of 125m (120m solid) was chosen as a standard pillar chainage distance used in Australian longwalls. It minimises the requirement for cut throughs, maximising advance rates while reducing the requirement for stoppings and seals thus improving ventilation efficiency. It provides an acceptable distance for face ventilation using industry standard 18m3/sec auxiliary fans and 700mm rigid ventilation duct.

3.11.1.6 Longwall Block Width

Longwall technology has advanced considerably in recent years allowing block widths of up to 370m. While in theory increasing block width should improve resource recovery and productivity by minimising the number of gateroads and gateroad pillars, it can also have a negative impact by reducing the flexibility to layout blocks in the available spaces. Large block widths can lead to excessive sterilisation of resources due to the inability to fit large blocks to odd shapes or between geological or inferred boundaries. Where blocks cannot be aligned square to a limiting boundary, large blocks will leave larger wedges of un-mineable coal compared to smaller blocks.

For the Boggabri deposit a width of 250m was viewed as a good balance between modern longwall capabilities while still maintaining sufficient flexibility of design given the non uniform shape of the deposit. A width of 250m should also ensure the critical width for full subsidence is exceeded thus mitigating the potential for wind blast.

3.11.1.7 Working Heights

For both Development and Longwall operation, a minimum working height of 2.0m was viewed as a good compromise given the highly variable nature of the seam thicknesses both within individual seams and between the three targeted coal seam measures.

The value is driven primarily by the specification of the longwall which must be capable of operation in all three seams. This presented a significant challenge given that the upper Braymont averages between 5.0 - 6.0m in thickness with the middle Jeralong 2.8 - 3.0m and the lower Merriown 2.6 – 2.8m. With the coal measures on all seams thinning out and becoming oxidised at around 1.5m thickness, and with several seam splits and washout zones producing high variability in the thickness of the lower seams, a longwall capable of a range between 2.0 – 3.5m was seen as optimal.

This would allow maximum recovery of coal from the Jeralong and Merriown seams and reasonable recovery from the Braymont. The potential for top coal caving from the balance of the Braymont seam coal above the 3.5m horizon would improve Braymont recovery and enable one longwall specification to mine all seams with significant cost saving to the project.
The minimum development mining height of 2.0m could be an issue for clearances of equipment and would need to be investigated in a higher level study. A requirement to mine higher then 2.0m would not reduce the extent of longwall blocks only increase the dilution from development in zones with coal thickness less than 2.0m.

The maximum seam working height on Development was nominated as 3.3m. This was seen as an optimal working height given the expected coal strength, for the installation of services, and for ventilation efficiency. Operations above this height would slow development rates and make installation of services and ventilation appliances difficult. If development productivity and the other problems caused by increased height were not critical, then an opportunity in the Braymont seam would be available to mine at greater height for increased coal recovery. It is not believed that mining of this additional coal would prove to be efficient or economically justifiable.

As mentioned previously the longwall maximum working height has been designed at 3.5m on the basis of a compromise between maximising coal recovery on the Jeralong and Merriown seams while achieving reasonable recovery within the Braymont. The ability for one set of longwall equipment to mine all three seam levels was seen as a critical design requirement. It is thought that increasing the maximum cut height above 3.5m would result in the minimum cut height also having to increase commensurately above 2.0m. This would result in either an unacceptable increase in dilution, or an unacceptable reduction in the length of blocks available for mining on the Jeralong and Merriown seam levels.

3.11.1.8 Top Coal Caving

Top Coal Caving (TCC) is a method of mining thick seams that has been extensively used and proven in China (over 100 mines), with one mine in Australia (Austar) also successfully using the technique. The method entails the use of a second armoured face conveyor (AFC) installed behind the hydraulic longwall supports. The rear mounted AFC collects a percentage of any roof coal which cannot be mined by the first pass of the longwall shearer. It collects this coal along with a percentage of stone dilution as it caves in behind the longwall supports.

The method could have ideal application at the Boggabri mine by allowing greater recovery of the thicker Braymont seam coal while maintaining maximum recovery of the underlying Jeralong and Merriown seams. As the TCC equipment is bolt on, its use could be limited to the Braymont seam only allowing it to be removed and sold off prior to mining of the lower seams and without affecting performance of the longwall in these seams.

The success and recovery available from TCC is dependant on; the nature and strength of the coal seam and overlying strata, the depth of cover, and the degree to which dilution is accepted.

A great deal of research would be required to accurately predict the likely recovery from a top coal caving operation in the Braymont seam. The experience from Chinese operations is that +80% recoveries are achievable. For this study and costing a best case recovery of 60% from the available coal above the 3.5m horizon was used to produce an overall recovery of slightly over 80%. This equates to over 8.3MT of additional coal.

3.11.2 Place Change

The Place Change layout and mining reserve calculation was based on the following design criteria.

- 7 heading development panels for both Mains and side panels
- All roadways driven at 5.5m width.
- Mains pillar widths of 30m solid (35.5m centre to centre)
- Panel pillar widths of 19.5m solid (25m centre to centre)
- Barrier pillar left between panels of 30m
- Panel entry barrier width of 45m
- Maximum cut height of 3.5m
- Maximum recovery of pillars during retreat of 30%
- Minimum seam interburden of 7.5m
- Minimum seam overburden of 40m

The conceptual layout for the Place Change option on the Braymont seam utilising the preferred highwall entry is shown on Drawing 3.5

The increased roadway width to 5.5m has been made to improve coal recovery and is acceptable given the expected coal and roof strength. At a more detailed level, the Place Change roadway width would require careful design taking into consideration the planned depth of cut out for each mining plunge, and the expected standing time between cut out and application of roof support. Roadway widths in excess of 5.5m may be achievable and would further increase the overall coal recovery of the method.

A potential problem of the method will be the lack of access to completed panels once sealed. For panels on the eastern side of the Mains, the seam contour will make it difficult other then by remote submersible pumping, to prevent water accumulating in the overlaying Braymont and Jeralong seams. While this is offset by the fact that the method will not be designed to induce caving, the potential for loss will be increased as the non caved upper workings will have increased capacity for holding free flowing water. A non intended collapse of the interburden between levels would therefore have more serious consequence then if the workings had been more fully extracted and caved.

3.11.3 Wongawilli

The Wongawilli layout and reserve calculation was based on the following design criteria.

- 6 heading development Mains
- 3 heading panels with 70m Wongawilli Splits (7m Fenders).
- All roadways driven at 6.0m width.
- All pillar widths @ 33m solid (39m centre to centre).
- Pillars to be split twice during extraction leaving 3 x 7m Fenders.
- No barrier pillar left between adjacent panels.
- Panel entry barrier width of 100m
- Maximum cut height of 3.5m
- Maximum recovery of fenders during pillar extraction of 80%
- Minimum seam interburden of 7.5m
- Minimum seam overburden of 40m

The conceptual layout for the Wongawilli option on the Braymont seam utilising the preferred highwall entry is shown on Drawing 3.6

The increased roadway width of 6.0m improves recovery and aids in the application of breaker line supports during the extraction phase. The pillar dimension of 33m allows for them to be split into thirds by the driveage of two 6.0m roadways leaving three 7.0m solid fenders for secondary extraction.

As per Place Change, a problem with the layout will be lack of access to completed panels to ensure they are dry before extraction of the underlying seams. The fact that working are planned to be caved will minimise the water bearing capacity and ability to free flow but will remain a significant risk.

3.12 Mine Layout Selection

Table 3.1 Braymont Seam Mining Reserves Comparison (Million Tonnes)

Method	Development (1st Working)	Extraction (2nd Working)	LW TCC (3rd Working)	Total
Longwall	2,341	26,288	8,315	36,944
Place Change	13,590	5,342	0	18,932
Wongawilli	7,323	14,547	0	21,870

From the analysis of three prospective methods on the upper lying Braymont seam it is apparent that the Longwall technique is most likely to realise the greatest resource recovery. Even without the additional recovery from Top Coal Caving, the method is predicted to recover 30% more then its nearest Wongawilli rival.

The Place Change design has included an allowance of 30% recovery of the primary pillars through a second pass retreat partial extraction which would be at the upper end of expectation. With the Wongawilli method the design parameter of not leaving barrier pillars between panels would have to be further considered to address flooding and spontaneous combustion risks.

The issue of spontaneous combustion and general working safety would make the Wongawilli or any other CM based pillar extraction method extremely difficult to support with the expected high propensity to spontaneous combustion and with companies actively pursuing policies of zero harm. The deposit would have to be highly faulted to limit the layout of longwall blocks to gain any comparative advantage from reserve recovery.

For Place Change systems, in the absence of any defined faulting, that could limit the placement of Longwall blocks, the method has little chance of being able to recover coal comparable to a longwall. Its only real advantage would come if environmental sensitivities did not allow for subsidence, in which case its maintenance of standing pillars would have to be considered favourably.

From a productivity perspective, Longwall methods win easily with a capability to produce up to 7.0 Mt/annum from one longwall unit. An individual CM based production unit would be well placed to realise 0.5 Mt/annum. A Place Change or Wongawilli based mine in Australia, with similar workforce size, would therefore be targeting production at around 1.5 to 2.0 Mt/annum, well short of the capability of a Longwall.

While the Boggabri deposit is not expected to be wet, the seams are known to act as aquifers and abandoned workings can be expected to accumulate water. For multi-seam mining it will be critical to ensure overlying seams are not acting as reservoirs of stored water which could unleash catastrophic energy to the lower seam levels though an unplanned release. The Longwall method by the maintenance of a bleeder road around the perimeter of completed blocks, would offer the best means of ensuring all completed panels are drained.

Longwall methodology is clearly the most likely technique to have any comparable advantage to the existing opencut proposal and will be the only method in this study progressed to the underlying seams for total reserve estimations and for more detailed financial analysis.

While it is unlikely to recover anywhere near the reserves of the open cut, a longwall mine would produce with significantly less energy input. While outside the scope of this report, it would be an interesting further exercise to calculate the total energy balance between the two options. At the end of mining, the difference between the two in terms of nett energy produced may not be that different. The likely impost in forth coming years of an emissions tax (ETS) will add further beneficial weight to the underground option with significantly less energy input and overall production of greenhouse gases.

4.0 MINE DESIGN

4.1 Longwall Mine Layout

The mine layout design for each seam level was based on overlying the standard alignment for the Braymont seam onto the Jeralong and Merriown seam levels and then trimming or extending longwall positions as per the over riding design criteria.

The appended sequence of drawings for each seam level shows the respective mine layout superimposed against; depth of cover contours, seam split lines, seam thickness contours, parting contours, base seam floor RL contours, seam interburden contours and seam overburden to interburden ratio plans. Where seam thickness is affected by parting lines the seam thickness plan is a composite of the coal ply's that would be actually mined up to the parting level.

4.1.1 Longwall Design Drawing Register

Drawing 4.1	Braymont Seam Split Lines
Drawing 4.2	Braymont Seam Depth of Cover Contours
Drawing 4.3	Braymont Seam Composite Seam Thickness Contour
Drawing 4.4	Braymont Seam A3 Parting Contours
Drawing 4.5	Braymont Seam Floor RL Contours
Drawing 4.6	Jeralong Seam Split Lines
Drawing 4.7	Jeralong Seam Depth of Cover Contours
Drawing 4.8	Jeralong Seam Composite Seam Thickness Contours
Drawing 4.9	Jeralong Seam Interburden Contours to Braymont
Drawing 4.10	Jeralong Seam Floor RL Contours
Drawing 4.11	Merriown Seam Split Lines
Drawing 4.12	Merriown Seam Depth of Cover Contours
Drawing 4.13	Merriown Seam Composite Seam Thickness Contours
Drawing 4.14	Merriown Seam Interburden Contours to Jeralong
Drawing 4.15	Merriown Seam Overburden to Interburden Ratio Plan
Drawing 4.16	Merriown Seam Floor RL Contours

The principal design tenant of panel superimposition along with the other design parameters have been covered in the previous section and will not be reiterated here.

The general cutoff criteria applied for the designs included;

Depth of Cover < 40m
Seam Thickness < 2.0m
Interburden Thickness < 7.5m
Overburden to Interburden Ratio < 16

4.2 Surface Access Design

The principal access strategy has been based on utilisation of the projected opencut highwall face positions at 2011. This decision was made on the basis of minimising cost, with each of the targeted underground seams already having direct access to the respective coal seams through the opencut's system of benches. It is expected that not having to develop boxcuts and or drifts to access the coal measures will result in a significant cost saving and minimisation of disturbance to virgin land surface. Some minor realignment of the final opencut face positions and spoil dump profile has been made to suit the preferred underground entry alignment and to leave sufficient room for men and materials access and for the surface conveyor system for coal clearance.

4.2.1 Overland Conveyor and Personnel Access

The conceptual layout for underground highwall access entails each mining seam level having its own daylight penetrating Mains conveyor running to an overland conveyor linking the opencut benches to the existing truck haulage crusher dump. The overland conveyor is broken into two sections of 1.2km and 1.5km. The alignment change is required to minimise disruption to the projected spoil dump design. It also enables a surge stockpile to be constructed at the transition point to provide continuous feed to the wash plant and to allow the size and capacity of the second overland conveyor to be scaled down in size and cost.

A 60m wide corridor has been allowed for installation of the overland conveyor, power reticulation and for personnel and materials access. The highwall and overland access strategy is shown on Drawing 4.17.

The initial overland conveyor section, from the existing crusher pad, follows the natural surface contour to a position inside of the planned south-east projection for the opencut spoil dump. An area of 363,000m^2 of planned spoil dump space will need to be resumed to allow for this alignment. An equivalent area of 354,000 m^2 to the south-west is available as compensation. Additional spoil room is available by filling the gap currently left in the open cut design between the northern edge of the spoil dump and the Phase-1 opencut side wall. The requirement to leave this space would not exist if the underground option where to proceed. In addition there is significant room left on the Merriown bench level although this should preferably be kept open for underground laydown space. Drawing 4.18 shows the planned resumption of spoil dump space and options for its compensation.

The second section of overland conveyor continues along the natural surface contour before entering the open cut via a purpose constructed main access ramp to the Jeralong bench. From this level the conveyor would need to change gradient again to access the Braymont bench. The second overland conveyor is therefore complex in that it has a gentle positive gradient from the discharge point, followed by a steep negative gradient through the main access ramp to the Jeralong bench (1:11), followed by a steep positive gradient back up to the Braymont (1:14).

The Jeralong bench level becomes the main staging point, with internal secondary access ramps leading from this level up to the Braymont and down to the Merriown. It is presumed these ramps would be dozed from shot material as part of the final opencut process.

The main access ramp from surface RL to the Jeralong bench will be in virgin ground and will require blasting and excavation. A conceptual 60m wide corridor at 1:11 gradient would entail 414,000 bcm of excavation. While this has been allowed for in the underground methodology it is not completely clear how the opencut is planning to access its final reserves. It is probably a fair assumption that if the underground plan was to proceed, then this access ramp would already be in place as part of the opencut operation. Drawing 4.19 shows in more detail the proposed access and conveyor alignments for the highwall access strategy.

4.2.2 U/G Mains Conveyors

The concept design has the Mains conveyors in the Braymont and Jeralong Seams using the alternate central headings of the 6 heading Main's layout. This is done deliberately to create an offset of 30m in the day light penetration of the two conveyors enabling both conveyors to run direct from the underground operations onto the overland conveyor. The 30m separation allows for the intervening bench, with the Braymont conveyor close to the crest of this bench and the Jeralong conveyor running close to the toe line. Drawing 4.20 shows in more detail the concept for the daylight penetrating Mains conveyors.

If the 30m offset is inadequate to provide sufficient crest to toe clearance then three alternatives are available. The central mains pillar design could be made larger then 30m to provide the extra clearance with a slight reduction in overall mining reserves. Alternatively either the Jeralong or Braymont Mains could be offset by one pillar to create a 60m separation between the two conveyor headings. The last alternative would be to offset the Jeralong conveyor access by 30m with an additional cross-belt installed inside the portal entry to get back in alignment with the Mains. This would result in no change to longwall reserves with a slight increase in Development reserves due to the extra driveage.

The Mains conveyor access for the Merriown seam has no option other then to be offset by an additional side panel to provide adequate access room on the Jeralong bench. In addition to the internal underground cross belt, the daylight penetrating Mains conveyor is broken into two sections to allow for the alignment of the Merriown opencut access ramp. The design premise is to keep the in pit conveyors as “low key” as possible. A direct alignment from the portal to the overland conveyor could be possible but would require a substantial gantry conveyor and transfer system to be established.

4.2.3 Underground Operation Offices

The underground site offices, workshops, refuelling bay and materials laydown area would be incorporated into three available spaces, these are shown on Drawing 4.17 and include;

a) Laydown Area-1: An area of 990m x 178m (176,000m^2) to the south of the overland conveyor access corridor. This space occupies a partial balance of the land resumed from the original opencut spoil dump design.

b) Laydown Area-2: The second area of 103,000m^2 incorporates the opened up Jeralong boxcut bench floor to the south-east. This expanded boxcut with highwalls on three sides has a length of 470m and width of 220m.

c) Laydown Area-3: The third area of 116,500m^2 is the remaining bench space left on the Merriown seam level after allowing room for transport and conveyor access. A portion of this space may be required for open cut spoil dump room to compensate for the current design dump area resumed for mine access as part of this plan. Utilisation of this space will however help to minimise the requirement for virgin land disturbance and should if possible be kept for laydown purposes.

The original concept was to have all site offices installed on the Jeralong bench space to minimise the requirement for additional land disturbance. The nature of the enclosed boxcut however would probably preclude this for ergonomic reasons. The revised concept would be for the main underground offices, stores and maintenance facilities to be located outside of the open cut in the first laydown area adjacent to the overland conveyor. Secondary shift marshalling, crib and refuelling facilities would still be located on the Jeralong bench space to minimise travel times in the mining cycle. The balance of all three spaces would be made available for the storage of supplies and mining equipment.

4.2.4 Main Fan and Underground Pit Feeder Access

Access to the main fans and underground sub station would be via the Leard Forest Road. A service access road of nominal 20m width would need to be established branching off at the

294RL and following this contour for 946m. Drawing 4.20 shows in detail the concept design for the fan access and services road.

A portion of both the Leard Forest and the services access road will be subject to full subsidence from the 1st longwall block of both the Jeralong and Merriown seams and will require reconstruction work after these longwalls have passed through. The roads will not however be affected by longwall subsidence from the Braymont seam. The remaining portion of the service access road runs parallel with the first maingate travel road of the Jeralong and Merriown seams and may be subjected to edge effects from the subsidence of these seams.

At the end of this access road two pad areas will need to be established. The first pad, nominally 150m x 100m, will be for the main vent shaft, underground fans, fan house and electrics. The position of the vent shaft has been offset from the main underground headings in order to reduce the required depth for shaft sinking to the base of the Merriown seam level. At the maximum proposed offset of 230m, the total shaft depth required will be reduced from 95m to 73m. The exact position of the vent shaft would need to be determined as a trade off between the cost of shaft excavation versus the cost of additional coal driveage. This calculation would need to take into account the negative ventilation effect of additional driveage and of course allow for value of coal mined in the process. Drawing 4.20 shows how shaft depth decreases as its position is offset to the south-west.

The second pad, nominally 170 x 150m, will site the main surface substation for the underground electrical supply, with power distributed to the underground via boreholes. Other facilities located within this defined area above the outbye section of Main Headings would include the main compressors, solsenic storage tanks, gas monitoring shed, and drop holes for the supply of bulk stone dust, concrete and gravel to the underground works. The exact configuration of this pad has not been completed at this level of study however it is assumed that sufficient space would be available within the allocated area.

All of the fixed infrastructure established on these pads, including the ventilation shaft will to be kept clear of subsidence effects from the first longwall blocks of the Jeralong and Merriown seam levels.

4.2.5 Surface Power Reticulation

Two options for running power to the underground sub station were investigated with only one carried forward as a suitable alternative.

The first identified option was to utilise the Leard Forest Road with power branched off from the main supply feeder at the intersection of the forest road with the main final product coal truck haulage road. The supply line would then utilise the service access road up to the main sub.

The preferred option is to continue the existing mine supply feeder line from its current terminus at the ROM stockpile and crusher area, along the side of the new overland conveyor corridor, bridging the Braymont boxcut to above the final highwall position and then skirting the final highwall at a 40m crest offset to the main sub. Refer to the main overview Drawing 4.17 for the position of the preferred power reticulation alignment.

The advantage of this route is threefold; firstly it is shorter then the first option at 4,045m (opposed to 4,121m), secondly it follows the alignment of other facilities that will require power reticulation avoiding double handling, and last it is free from any longwall subsidence effects, unlike the first option.

4.2.6 Water Supply

It is assumed that a potable water supply facility would be available from the existing opencut administration area. A pipeline linking this facility with the underground office areas would need to be established as part of the underground set up. An elevated 50,000 litre capacity storage tank would need to be established at the administration area with larger 200,000 tank(s) at ground level for back up. The foot print for the potable water supply and storage system would not exceed the land use areas already defined.

A 45 megalitre raw water dam or “turkeys nest” could be established at the north-east end of Laydown Area-1 (refer Drawings 4.17 and 4.19). This dam would service raw water requirements for general mine use and for fire fighting capability. It would be backed up by the existing surface storage dams on the mining lease and by the mine dewatering settling dam. The settling dam would be constructed close to the highwall portal entries on the Merriown Bench Level between Laydown Area-3 and north-east edge of the opencut spoil dump. Excavation of virgin bedrock will be required to form this settling dam as the bench RL’s slope adversely to the north-east rather then the preferred south-west which would have allowed for natural pondage.

4.2.7 Land Disturbance Summary

The following table summarises the expected land disturbance for the concept underground mine. The table breaks down land usages between those requiring access to virgin undisturbed land and those requiring access to land already disturbed by the open cut. Where a land use is planned for an area already accounted for it is summarised separately so as not to double count.

For the opencut spoil dump an adjustment has been made to allow for the area resumed for underground / overland conveyor access and the area added on in compensation. The result of this balance is a marginal nett decrease in virgin land disturbance. No disturbance allowance has been made for any follow up exploration drilling or seismic programmes.

The estimated additional virgin land that will require disturbance is 94.5Ha. This includes a provision of a 40m corridor around the final highwall for inspection and installation of power supply lines. This provision, while included as virgin land disturbance, is probably a double up in so far as the disturbance would most likely already have been made as part of the opencut operation.

Table 4.1 Land Disturbance Summary

Designated Usage	Virgin Ground (m^2)	Within O/C (m^2)	Within Laydown (m^2)
Resumed Spoil Access Corridor	-362,606	-	-
Additional Spoil Room (South)	354,496	-	-
Additional Spoil Room (West)	-	63,290	-
U/G Tailings Disposal Plan	445,264		
Mine Access Corridor-1	71,220	-	-
Mine Access Corridor-2	42,660	-	-
Mine Access Stockpile Allowance	3,582	-	-
Jeralong Access Ramp	19,500	-	-
Mine Services Access Rd-1	14,240	-	-
Mine Services Access Rd-2	4,680	-	-
Main Fan Compound	15,000	-	-
Services Compound	25,500	-	-
Highwall Access Strip (40m wide)	135,040	-	-
Laydown Area-1	176,270	-	-
Laydown Area-2	-	102,786	-
Laydown Area-3	-	116,544	-
Sediment Dam / Sump	-	19,900	-
Raw Water Dam	-	-	10,000
Main Office Complex	-	-	15,000
U/G Office Complex	-	-	10,000
Total	**944,846**	**302,520**	**35,000**

4.3 Geotechnical / Strata Control

4.3.1 Literature Review

Detailed information on immediate roof, floor coal and parting strengths for each of the targeted coal seams was not able to be interpreted from the information provided by Idemitsu. The Geotechnical Assessment report (5.2) provided anecdotal information on the general conditions to be expected. Statements from this report included;

"The mining area appears to be relatively free from faulting".
"Conglomerate (~62%) exists in beds up to 30m thick".
"All rocks (except coal) exhibited some slaking"
"Rocks immediately adjacent to the coal seams had the highest slaking potential"
"Groundwater levels appear to be quite low (100m). Water loss occurred from all upper seams indicating a significant permeability"
"All rock types are characterised by relatively high strength"
"The relatively week floor materials have implications for trafficability"
"Bedding planes are virtually absent from the conglomerate sequence"
"Laminates have high strength anisotropy".
"The material strength of highly laminated, fine grain floor material is relatively low".
"Wall stability in the massive conglomerate and sandstones should be excellent"

And from the Boggabri Project Geological Report (October 1992)
"Conglomerate frequently forms the immediate roof of the coal seams within the sequence across the project area".
"The conglomerates and coarse sandstones intersected during the various drilling programmes showed considerable variation in competency. Generally they are massive, poorly sorted and have a low matrix content".

Table 4.2 Rock Property Test Results Borehole AB001 (From Geotech Report 5.2)

Interval (m)	Rock Type	Tensile Strength (MPa)	UCS (MPa)	Young's Modulus (MPa)	Density (kg/m^3)
55.696 - 55.80	Laminite	-	28.55	1560	2166
55.610 - 55.69	Laminite	4.84	-	-	2216
55.210 - 55.40	Sandstone	4.15	46.82	6410	2378
87.940 - 99.15	Conglomerate	2.5	28.42	11250	2199
96.140 - 96.30	Mudstone	2.84	46.57	6250	2374
117.17 - 117.4	Conglomerate	3.74	27.92	9620	2156
119.61 - 119.8	Sandstone	2.79	42.63	4690	2305

For reference, at this borehole location the target coal seams have the following depth of cover,

- Braymont Seam Depth of Cover = 56m
- Jeralong Seam Depth of Cover = 92m
- Merriown Seam Depth of Cover = 117m

From these comments and the results from Borehole AB001 it is concluded that the immediate roof for the targeted coal seams are likely to range between either moderate strength laminates to higher strength massive conglomerate. It is unlikely however for immediate roof strengths to be consistent and zones of severe weakness should also be expected. Slickensided joints can be expected however their incidence is believed to be more prevalent in the deeper seams below the Merriown level.

Immediate floor strengths are predicted to be weak and subject to high slaking potential. Keeping development roads dry and well ballasted will be critical. In the Braymont seam, development workings will need to take advantage of the additional coal thickness by leaving a minimum 300mm layer of coal in the floor to aid trafficability.

The anecdotal evidence is that coal strengths are expected to be moderate to high. This is backed up by test results from a report completed for a trial auger mining operation in the Merriown seam in 1993. UCS results from 4 coal samples returned values of 10, 15, 17 & 18 MPa.

4.3.2 Faulting and Seam Dip

The Boggabri coal block is believed to have been spared from more intense regional forces, by major fault lines outside of the block, which have acted as a pressure relief system. The block is predicted to be free from normal faulting with some minor thrust faulting predicted. The regional bed dip of 2º to the north-east with depositional variations of up to 8º should not create issues for the first working development and later extraction by longwall.

4.3.3 Seam Splitting

While the Boggabri deposit is heavily influenced by seam splitting, its influence is mainly concentrated in the A339 lease area outside of the scope of this study, and to the north-east of the final 2011 highwall position, which is difficult from a mine design and coal clearance perspective to gain access to in any case. Interestingly enough, none of the long term Phase-1 open cut design projection out to the A339 lease boundary is touched by the concept underground mine plan. Resumption to the Phase-1 opencut works could continue in this alignment after completion of the underground works, or concurrently if a non highwall access strategy were chosen.

Where seam splitting does affect the concept mine layout, particularly on longwall blocks east of the Mains, its effect will be mitigated by mining through the parting and accepting the higher dilution or by targeting the lower coal ply and leaving the parting in the roof. The nature of the strength of these coal partings is minimal and does require further analysis.

4.3.4 Roadway Support Strategy

From the information provided it is assumed that roof conditions will generally be good. An allowance of 4 x 1800mm fully encapsulated roof bolts and 1 x 1200mm fully encapsulated rib bolts per metre has been made for the cost and productivity model. The design roadway width of 5.0m together with the high strength coal and relatively shallow depth of cover should help to maintain stable roof conditions.

The costing and productivity model makes allowance for installation of a percentage of additional secondary support, roof and rib mesh, aswell as for the installation of tin cans in the tailgate return of each longwall block and for installation of monitoring hardware at regular intervals. The support density is believed to be conservatively within +- 30% estimation for this broad level study.

4.3.5 Portal Entries

Highwalls above the portal entries to the mine should be of exceptionally good standard given the expected strength of the conglomerate and absence of bedding planes. The worst case requiring the most intensive design will be the Braymont entries with a depth to natural surface ranging from 52 to 59m. This highwall will almost certainly have to be designed with an intervening catch berm to minimise the impact of falling material. The crest of the top weathered zone will also need to be dozed to a solid interface above the immediate portal entry areas. Similarly mesh will need to be pinned to the highwall above the portals to decelerate any loose scat that does fall. Reinforced concrete or steel arches will need to be designed to project out a safe distance from the initial underground workings in each case.
The reduced height of the Jeralong bench at 40m and in particular the Merriown bench at 25m, both without weathered zones, should aid in reducing the complexity and cost of the portal access support and entry structures.

4.3.6 Subsidence

Subsidence effects from longwall operations at the Boggabri mine will vary considerably and will require more detailed analysis to predict accurately. The massive conglomerate overburden and interburden structures on the one hand will serve to minimise subsidence effects. But on the other hand, the shallow depth of cover, the 250m longwall block widths, and the superimposition from multi level mining will cause to exacerbate the effect.

With combined coal extraction ranging between 2.0m for single Merriown mining, up to potentially 10.0m, where all three seams are mined in alignment (and at their thickest), subsidence is likely to range anywhere from minimal disturbance up to 6.0m displacement. Significant die back of older established trees in these high displacement zones can be expected.

The only civil works structures to be affected by mine subsidence, will be the existing Leard Forest Road, and the "yet to be constructed" Mine Services Access Road. As these roads will only be of an "all weather" gravel type construction, their requirement for repairs after subsidence should be minimal. No existing or future surface dams are expected to be impacted by subsidence.

4.4 Ventilation

With seam gas not expected to present in significant quantities, the mine ventilation design needs to be based on reducing total mine pressure as a principal control against spontaneous combustion.

To this end the key mine ventilation design aspects centred on;

- Provision of a 6 Heading Mains.
- Provision for Flanking Returns (with one Side Dual Returned).
- High Standards for Ventilation Control Device Construction.
- "U" type Longwall Ventilation with flood intakes.
- Twin Heading Gateroads with Homotropal conveyor installation.
- 5.0m Diameter Main Vent Shaft close to the Portal Entries.

4.4.1 Ventilation Simulation

In order to predict the likely mine pressures and power requirement for the mine ventilation system, a mine ventilation model was established using Ventsim software (Refer Figure 4.21). The model was based on a prediction of the worst case mine ventilation layout with production from the Merriown seam and with an additional requirement to maintain bleed ventilation to the overlaying Jeralong seam for inspection and pump out purposes. It was presumed that access to the completed Braymont seam level would not be required at this stage with the portal entries to this level sealed.

The ventilation model was established for the point in time where both the primary and secondary Mains are completed on the Merriown level with the longwall just commencing production from the first north-west block. It was theorised, that at this point in time, the remaining north-west blocks would have been completed development and be ready for future longwall production. The two Development panels are modeled working from the north-eastern gateroads.

For the Jeralong seam level, a single open ended mine roadway connected to the ventilation shaft, was used to represent the mine resistance from this level. The resistance of this string was artificially adjusted to model more expansive workings and allow ~50m^3/sec which was thought to be adequate for inspection and dewatering access purposes.

The model predicted the overall mine resistance for the mine at this point in time to be 0.02014Ns^2/m^8. At this resistance, a forced total mine ventilation quantity of 250m^3/sec was found to provide a comfortable level of ventilation to the longwall and development panels while still leaving sufficient bleed airflow for completed standby blocks and the overlaying Jeralong seam. At this quantity the model predicts mine ventilation pressure to be 1.3 kPa with an airpower of 315kW resulting in an annual running cost of $M1.5 ($0.1/kWhr). This "worst case" mine ventilation pressure is not expected to be excessive from a spontaneous combustion perspective.

A summary of the mine ventilation face quantities predicted, for the worst case point in time, is listed in the Table 4.3;

Table 4.3 Ventilation Modelling Summary

Location	**Face Quantity (m^3/sec)**
Longwall (Merriown)	65.0
Development-1 (Merriown)	42.0
Development-2 (Merriown)	31.0
Mains and Completed Blocks (Merriown)	37.4
Jeralong Seam Access Ventilation	47.2
Braymont Seam Ventilation (Sealed)	0
Total:	**222.6**
Ventilation Efficiency:	**222.6 / 250 = 89%**

The ventilation efficiency represented by the mine model is high at 89% as a consequence of the broad brush nature of the model's construction, with less leakage paths then would be the case in reality. In addition the resistance values for the Mains and Gateroad stoppings have assumed a very high standard of construction. An allowance for additional leakage up to 10% would however adequately provide for this deficiency and still leave acceptable ventilation quantities to the working faces and stand bye areas. Provision for additional leakage would have the benefit of reducing mine pressures so long as the reduction in face quantities is acceptable.

4.4.2 Main Return Shaft

The ventilation model indicates that the project should be able to be completed with only a single main return shaft located close to pit bottom. While this will cause mine ventilation pressures to be higher than that if a secondary shaft were to be installed inbye at a later date, the expected pressures from the single shaft option are not excessive and should be manageable. The cost of establishing a secondary inbye shaft would be large in lieu of the increased depth of cover, and the cost of gaining power and personnel access to its location on the surface.

As mentioned in Section 4.0, the design location of the primary ventilation shaft would be subject to a cost benefit analysis with the total shaft depth able to be reduced by offsetting its position to the south west. For the modeling work completed in this report the vent shaft was offset 240m by a dual heading roadway reducing the depth of cover to the Merriown seam from 95m to 73m

4.4.3 Ventilation Summary

In summary, the six heading Mains design with provision for a balanced three intakes and two return roadways, combined with an average 5.0m x 3.0m roadway profile, should ensure mine ventilation pressures are kept relatively low to mitigate the potential for spontaneous combustion. The mines main fan(s) will need to have the capability of generating airflow of up to $250m^3$/sec at a pressure of 1.3kPa to cover the expected worst case point in time with regard ventilation resistance and the mine schedule.

4.5 Mine Equipment

The Boggabri concept longwall mine has been designed to produce at an average rate of 5.0MT per annum (5.3MT including Development) over a 21 year period using longwall retreat methodology with the ability to Top Coal Cave.

4.5.1 Longwall Design

A major design constraint of the Boggabri deposit with regard the use of Longwall equipment is the highly variable nature of the seam thickness; in particular the high variation between the upper Braymont seam, with an available thickness up to 6.0m, and the underlying Jeralong and Merriown seams, whose thickness will average half this value. The design problem is complicated by the fact that no particular seam level has sufficient reserves to sustain a longwall for its full life cycle. Given the high capital cost of the hardware, with limited resale value, it was seen as tantamount that the one longwall unit be capable of mining in all three seams. The total underground reserves indentified at Boggabri, neatly fits into the modern day life expectation for a single longwall unit.

Designing to suit the thicker Braymont seam only would severely impact upon the lower seams with the larger roof supports (chocks) unable to adequately compress to fit within the reduced seam profile thus sterilising a significant proportion of the reserves that a smaller longwall would otherwise be able to handle. Similarly designing the longwall for the narrower Jeralong and Merriown seams would result in wastage of top coal in the Braymont seam, with the smaller equipment unable to reach the top of coal.

To maximise resource recovery a compromise cutting range on first pass working between 2.0m to 3.5m was found to produce the best overall recovery when applied across all seams. The introduction and proven effectiveness of Top Coal Caving, was seen as an opportunity for recovering some of the Braymont coal above the 3.5m horizon. The fact that this equipment can be modularised and bolted on or off separately meant that its use in the Braymont would not compromise the efficiency of longwall operation in the lower seams.

A longwall width of 250m was chosen as a good compromise between taking advantage of modern longwall drive technology, with widths of up to 370m now common, while still providing flexibility to enable layout of the blocks within the inconsistent resource shape. The design width of the longwall blocks needs careful consideration to ensure consistent caving occurs behind the longwall. A larger block width will aid in this requirement and mitigate the potential for wind blast.

The longwall shearer, maingate and tailgate drives together with maingate crusher, beam stage loader (BSL) and monorail system were all factored utilising existing standard technology based on a design capacity of 4,500 tonne per hour.

4.5.2 Development Panel Design

The Development Continuous Miners were factored to be full head single pass machines with a cutting range ability between 2.0 – 3.5m. Roof and rib support will be installed utilising on board bolting rigs.

Coal clearance from the CM to the panel boot end is planned utilising standard shuttle car technology loading onto mobile boot ends. A lot of research and development in industry is currently going into the design of continuous haulage systems to eliminate the shuttle car bottleneck. At this stage the systems remain largely unproven and have not been considered here.

Panel ventilation will be provided by 18m^3/sec auxiliary fans with standard 720mm rigid vent tubing. Monorail ventilation systems were not considered on the basis of insufficient clearance room where development roads close to 2.0m height.

The capital estimation provides for two complete Development units each with two shuttle cars. For Mains driveage the opportunity for both cars to be operated concurrently would exist. For gateroad development, the dual heading design precludes dual shuttle car operation. In this instance the second car would be kept as a spare.

4.5.3 Outbye Mobile Equipment

An allowance for a full suite of up to 18 generic mobile diesel support vehicles has been made in the capital costing. Such vehicles will include; man transports (PJB's/Drift Runners), load haul dump vehicles (Eimco's), a mine grader, power tram and bobcat. Service work will be assisted by the use of quick release attachments for load haul dump vehicles including; buckets, forks, dust pods, cable realers, man riding baskets, pipe installers, and other work platforms. General mine supplies will be transported by towed flatbed and boxed trailers.

Other specialty mobile equipment (shearer transporter, mine dozer, chock carriers and chariots) required for longwall relocations are allowed for as a hire provision during these events.

4.5.4 U/G Coal Clearance

The following provisions have been made in the capital estimation for the staged purchase and installation of underground coal clearance hardware;

- Mains Trunk: 3 sets of drives and transfers, with 5km of installed belt @ 6,000 tph.
- Development: 4 sets of drives and transfers, with 6km of installed belt @ 1,200 tph.
- Longwall: 2 sets of drives and transfers, with 3km of installed belt @ 4,500 tph.

4.5.5 Other Outbye Equipment

The capital costing makes general provision for a full suite of outbye equipment essential for sustained mining. The provision includes allowance for;

- Pumps
- Pipes (air, water, dewatering)
- Surface air compressors
- All electrical hardware (transformers, starters, cables)
- Back up surface generating capacity (for main fans, gas monitoring)
- Mine communication systems (phones, DACs, fibre cables, control room)
- Gas monitoring facilities (real time, tube bundle, machine mount, hand held)
- Fire fighting infrastructure (extinguishers, hydrants, hoses, nozzles etc)
- Mine rescue and self escape (first aid, self rescuers, CABRE systems)
- Wash down, refueling bays
- Crib Room Facilities

4.6 Productivity

Achievable mining productivity rates are governed by the equipment selection and the geological and geotechnical environment of the mining operation.

4.6.1 Roster

The mine will operate 365 days of the year minus a 24 hour shut down over Christmas day. It has been assumed that operators will work an equal time roster, either a 4 on 4 off or 7 on 7 off roster. Both roster arrangements will result in similar productivities and operating costs. Shift times will be 10 hours 7 days a week on both day and night shift.

A 4 hour maintenance window will occur every morning between night shift finishing and day shift commencing. An additional maintenance shift will occur one shift per week on the first day back for operators; this will coincide with training and crew briefings following their week off.

This roster results in 13, 10 hour production shifts per week and a total of 28 hours of maintenance per week. This will ensure equipment is maintained appropriately and breakdowns and mining delays are minimised.

Table 4.4 provides an approximate break down of expected shift delays over the course of an average shift and Table 4.5 and 4.6 summarise the available and utilised shift times.

Table 4.4 Shift Down Time Summary

	Min/shift
Tool Box Talk	10
Travel to UG	20
Startup Inspections	10
Smoko	0
Crib Break	30
Travel to Surface	20
Unplanned Breakdown	50
Mining Condition Delays	30
Total Lost Time	170
Mining Delays (Bolting, SC wait etc)	250

Table 4.5 Availability Build up

Number Days Per Week	7
Number Unit Shifts Per Day	2
Number Hours Per Shift	10
Number Shifts Per Week	14
Number Shifts Per Year	676
Number Min Per Shift	600
Total Lost Time	-170
Avail Min Per Shift	430
Mining Delays	-250
Utilised Min per Shift	180

Table 4.6 Availability Results

Annual Shift Availability	92.6%	Production Shifts / Total Shifts
Shift Availability	71.7%	Available Minutes / Total Shift Minutes
Shift Utilisation	30.0%	Cutting Hours per shift / Total Shift Minutes
Total Utilisation	27.8%	Shift Utilisation / Available Shifts

4.6.2 Equipment Productivity

For this level of study we have assumed that fit for purpose new mining equipment will be purchased. Basic bolter miner continuous miners are commonly used in all longwall mines in Australia and it would be recommended to utilise these basic machines. Implementing new systems of work or more advanced technologies could create a risk of delayed production due to teething issues and operator and maintainer familiarisation.

The sort of development equipment recommended commonly achieves production rates within Australia of between 5 and 40m per shift, with averages ranging between 10 and 20m/shift. For the Boggabri underground we have assumed average mining rates for development units of 12m/shift in the main headings and 15m/shift in the gate roads. Development production rates are summarised in Table 4.7

Table 4.7 Development Production Assumptions

	Mains Drivage	Gate Road Drivage
Average Drivage rate (m/shift)	12	15
First Panel Production Rate (% of peak)	80%	80%
Panel relocation (shifts)	5	10
Ramp Up shifts per panel	10	10
Ramp Up Shifts Production rate (% of peak)	50%	50%

Longwall production assumptions are based off benchmarking against current operating mines and current projects. The approach used was to approximate shift retreat rates and calculate an annual production rate. The annual production rate would place the Boggabri underground in the top quartile of producing underground coal mines in Australia. To our knowledge all Longwall designs currently in feasibility or construction are targeting annual ROM production of over 5Mt. Generally it has become evident that with the large capital expenditures required to construct a Greenfield Longwall mine a minimum annual production of 5Mt is being targeted to ensure capital pay back.

Table 4.8 Longwall Production Assumptions

	Longwall	LTCC
Retreat (m/shift)	10	6.4*
Relocation (days)	25	25
Bolt Up (days)	14	14
Ramp up in new block (days)	7	7
Ramp up productivity (% of Peak)	50%	50%
First panel Production Rate (% of peak)	80%	80%

*Note: Average shift production is consistent for LTCC and conventional LW operations.

4.7 Benchmarking

Each mining operation has a specific set of operational constraints which drive their cost and production capabilities. Some of the key consideration that affect the profitability of the mine include the resource, geological and geotechnical setting, the selection of mining type, the age and type of equipment being used, operators experience, capacity constraints in conveyors or processing, and market constraints. Making direct comparisons with operations become problematic due to the massive variations in geological setting and other drivers, however an industry wide bench marking analysis enables operations to see how they compare with the Australian Underground industry norms as well as providing as sense check against production capabilities, operating and capital costs.

WDS Consulting has access to a range of operations and their current performance as well as industry wide mine ranking data.

From the available data the designed Boggabri underground longwall mine benchmarking is summarised:

- The mine will be in the top 20% for ROM production. Current best practice in Australia is approximately 7Mtpa, which is approximately 30% higher than the average planned production from Boggabri.
- To the knowledge of WDS consulting the majority of underground longwall mines being designed are currently targeting ROM production rates of between 5Mtpa up to 8Mtpa.
- The mine will be in the top 20% for ROM operating costs, at $21.15 /ROM tonne the underground operating costs would be approximately 150% higher than the current cheapest producer in Australia.
- The product or FOB operating cost is in the top 25%. The lower ranking compared to ROM costs is due to the relatively high dilution and low recovery after washing.
- Mine construction capital is invariably the most difficult comparison to make due to the complexity of each mine build as well as the lack of comparable and recent data. There are currently several underground feasibility studies for similar capacity mines in progress. Capital estimates for these studies is ranging between $300M for a Brownfield site that already has surface infrastructure, to over $1.8B for a large capacity Greenfield site with major infrastructure requirements. Two comparable operations wish additional requirements of rail loop, rail spur line, significant portal access requirements and power and water infrastructure requirements are in the process of finalising feasibility studies. These operations have estimated capital requirements of between $900M and $1.1B.

This high level bench marking study provides confidence in the estimated production, operating cost and capital cost estimates.

Recent press releases from Whitehaven Coal relating to the neighboring North Narrabri Longwall Project have confirmed the selected mining philosophy using a LTCC face in both top coal caving and normal longwall configurations. Whitehaven are targeting 6Mtpa ROM from the underground.

4.8 Mining Schedule

Mine development is to commence is 2011 with portal drivage and the initial mains roadways driven by a contractor. The development contractor will be required to continue developing approximately 7km of the 6 heading mains whilst the Boggabri development crews commence driving the first longwall gateroads. The contract miner is required to help build sufficient development float such that the two Boggabri development crews are capable of ensuring sufficient development float for the rest of mine life.

The initial drivage lead time is minimised due to the relatively short lengths of longwall blocks. This means only 12 months of development is required prior to longwall production commencing.

Development of mains and gate roads increases into 2012 when initial Longwall production commences. The following graph, Figure 4.1, shows the annual production profile. Longwall production ranges between 4 and 6Mtpa with average annual production approximately 5.0Mtpa. Development rates range between 9.5 and 13km per year.

This development requirement should be easily achievable by 2 development sections. Other mines in the country achieve up to 14km per year with 1 development unit, however there are also mines that require 3 units for this volume of drivage. With the expected favourable mining conditions 2 continuous miner sections should be adequate.

Total run of mine production ranges between 4.1 and 6.4Mtpa, with average annual production of approximately 5.3Mtpa. With high volumes of dilution averaging 12.80% of the ROM product per year and peaking at 19.8% (on an annual basis) the resulting product recovery is moderate ranging between 68% and 86% per annum. Figure 4.2 summarises the annual production figures.

Annual Product tonnes (Free on Rail) range between 5.0 and 2.8Mtpa with average production of approximately 4.0Mtpa when operating at full production.

Figure 4.1 Annual Production

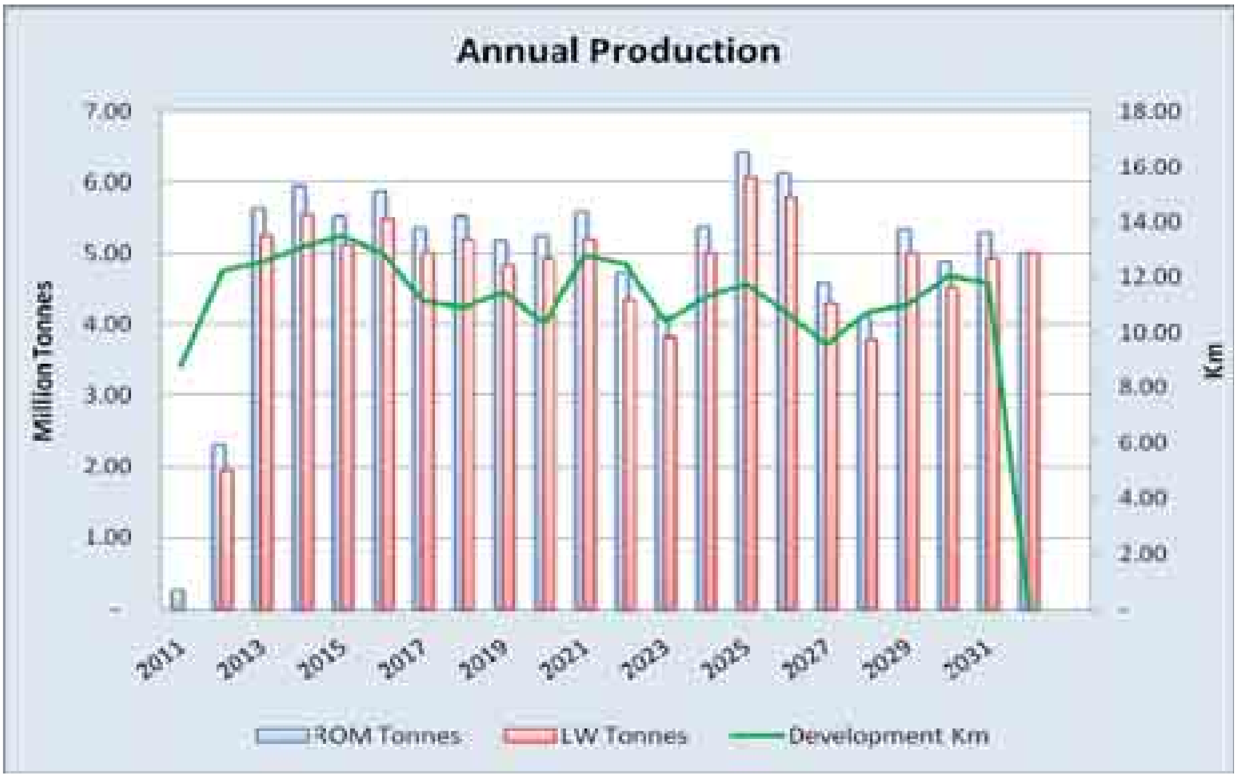
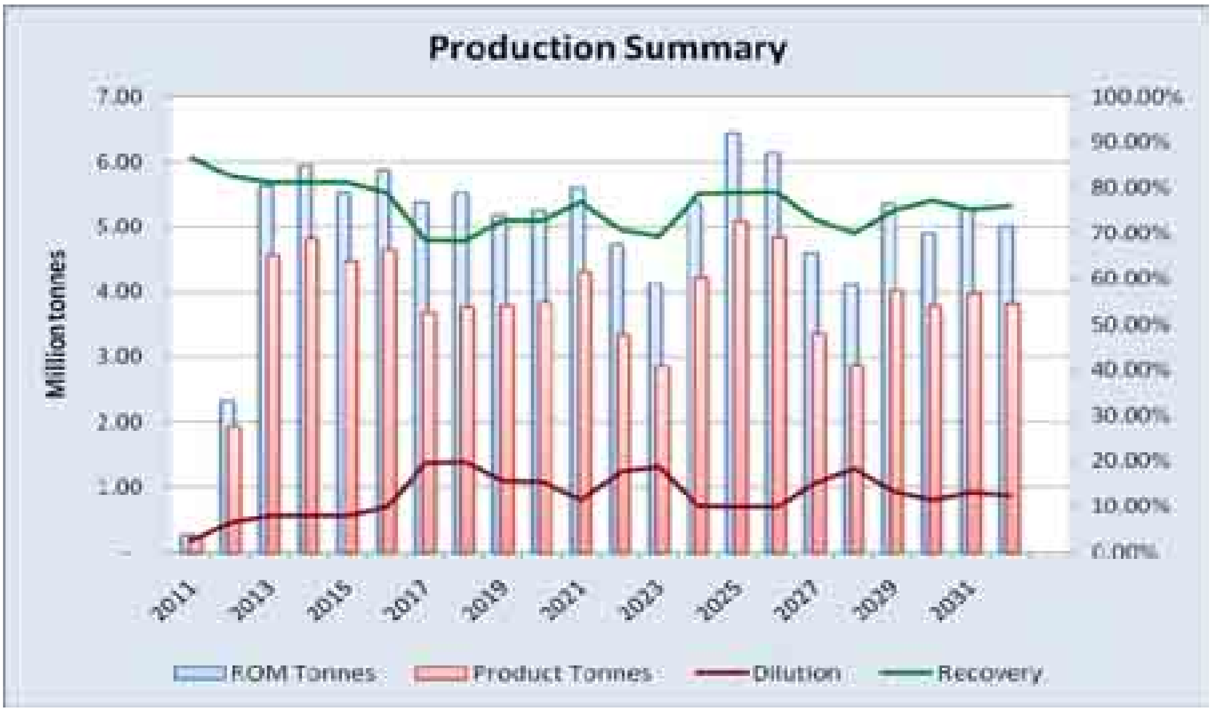


Figure 4.2 Production Summary



4.9 Reserves

Total mineable coal reserves are approximately 94.6Mt over the life of the underground operations. Total mined ROM including dilution and coal is approximately 108.5Mt. Total ROM recovery is 75.7% with total salable product of 82.1Mt. Approximately 86.7% of the mineable coal reserves report to the product. Table 4.9 and 4.10 summarise the reserves by seam. Appendix-3 provides the full reserve estimate tables and assumptions.

Table 4.9 Mined Coal Reserves

	Development Metres	**Development Tonnes**	**Longwall Tonnes**
Braymont Seam	111,993	2,342,524	34,603,149
Jeralong Seam	131,278	2,500,100	29,169,709
Merriown Seam	123,673	1,750,671	23,804,172
TOTAL	**366,944**	**6,593,296**	**87,577,031**

Table 4.10 Boggabri Underground Production Summary

	Coal Tonnes	**Total ROM Tonnes**	**Dilution %**	**Recovery**	**PRODUCT TONNES**
Braymont Seam	36,945,674	42,337,245	12.7%	75.7%	32,068,937
Jeralong Seam	31,669,810	36,025,297	12.1%	76.4%	27,538,714
Merriown Seam	26,010,018	30,146,954	13.7%	74.7%	22,513,633
TOTAL	**94,625,501**	**108,509,496**	**12.8%**	**75.7%**	**82,121,284**

5.0 MINE INFRASTRUCTURE AND FACILITIES

This section describes the infrastructure of the underground mine and includes the systems listed below:

- Access roads and laydown areas
- Coal clearance system
- Power reticulation
- Mine dewatering
- Mine ventilation
- Reticulated mechanical services (raw water, compressed air, etc)
- Fire services
- Miscellaneous services (stone dust, diesel, concrete and ballast drop holes)
- Underground communications.

The Mine Ventilation requirements are addressed in Section 4. Longwall and continuous mining equipment is not included in this section, but is described elsewhere in this report. The CHPP is addressed in Section 6. The site surface infrastructure and facilities are shown on Drawing 4.17, 4.19 & 4.20.

A Mine Development Schedule has been developed at this time to provide input into the cost model and subsequent evaluations.

5.1 Access Roads

The main access road will connect the industrial area and other infrastructure to the Leard Forest road in the southern part of the lease area. This will be an all weather road which will run parallel to the overland conveyor and provide access to the laydown areas for admin buildings, workshops, stores, refueling bay, crib room and muster area.

A service access road is also designed along the Northern part of the lease area to access the ventilation shaft and the service boreholes. This service road branches off towards the east from the Leard Forest road. It is anticipated that the access road to the ventilation shaft will not carry significant traffic volumes and therefore will be unsealed.

The internal roads have been designed with reference to the ultimate mine facility layout. Internal roads include all other roads within the industrial area which give access to buildings and other facilities, ROM Stockpile, man and material drifts and overland conveyor.

5.2 Laydown Areas

The laydown areas have been designed considering the access to the mine portals and areas having minimal environmental impacts. The proximity to the access roads has also been a point of consideration. Laydown Area-1 includes the main administration building, workshops, stores and backup compressors. Laydown Area-2 includes the muster area, crib rooms and the refueling bay. Laydown Area-3 has also been designed considering the future requirements during the detailed design phase.

5.3 Overland Conveyor

ROM from the underground mine will be deposited onto a stockpile and drawn down through three vibrating feeders. The stockpile will be managed using dozers to push out and reclaim. The reclaim rate will be controlled via a feedback from the belt weightometer to control the vibratory feeders.

The coal produced from the underground operations is transported to the CPP through an overland conveyor running parallel to the main access road on the southern part of the lease area. The main trunk conveyors from each seam discharge coal on to the overland conveyor. The overland conveyor delivers the coal to a stockpile from where it is reclaimed via a conveyor to a surge bin (250 T) with a single feeder to feed the CPP feed conveyor with the rate controlled via a feedback loop from a belt weightometer. The overland conveyor is broken into two sections of 1.2km and 1.5km. The alignment change is required to minimise disruption to the projected spoil dump design. It also enables a surge stockpile to be constructed at the transition point to provide continuous feed to the wash plant and to allow the second overland conveyor, being fed by the stockpile, to be scaled down in size and cost.

The second section of overland conveyor runs along the natural surface contour and enters the opencut area along the main access ramp to the Jeralong bench level. From this bench the conveyor grades up again to the Braymont bench.

5.4 Underground Conveyors

The main gate conveyors will receive material at 4500 tonnes per hour from the longwall in their production configuration and at 600 tonnes per hour intermittently from continuous miners in their development configuration. The heading development conveyor will receive material at 600 tonnes per hour intermittently from a continuous miner. The nominal capacity of the Mains Conveyor is 5200 tonnes per hour.

The main gate conveyors will be fitted with VVVF drives to facilitate coordinated and controlled starting and stopping of upstream and downstream conveyors for all combinations of load, length and lift. All underground VVVF substations will be the same size type and design in support of interchangeability and minimisation of spares and required knowledge base. Each conveyor's set of VVVF drives will be interconnected via a fibre optic cable based network.

5.5 Power Reticulation

The power lines for underground operations and the fan feeder for the ventilation fan is also designed to run parallel to the main access road and the overland conveyor. A feeder off the main power line will feed power to the substation in the vicinity of the laydown area-1 to service the overland conveyors, stores, main admin building, workshop, muster area, crib room and the refueling bay and the pumps in the raw water dam. Another substation will be commissioned near the ventilation shaft feeding power to the ventilation fans and to the underground operations apart from the other service facilities on the surface around the portal area.

The power reticulation system includes both surface and underground substations that interface with the existing site infrastructure. The surface power reticulation includes supplies to the surface Mains Conveyor Drives and supply to the upcast shaft substation. The underground reticulation system will be based on a system of radial feeds from the pit bottom substation to the dewatering pumps, conveyors, longwall miner and continuous miners. Reticulation to the substations will be by 11kV power cable.

Earthing for power systems shall be via a surface installed mine earth, and earth faults shall be limited by an impedance earth system. The surface conveyor structure and other electrically conducting structures, having the potential of transferring lightning strike potential energy to the underground, will have isolation sections.

5.6 Mine Dewatering

Water inflow into the underground workings will vary depending on each phase of development and the amount of hydro-geological disturbance caused by that development. The presence of numerous coal seams in the sequence, the relatively shallow cover in sections and potentially water retaining upper mined out seams could result in moderate water inflows from the access entries, ventilation shaft and the porous seams. While water make in the seams has been not significant to date, the apparent porous nature of the coal seams provides a ready aquifer if conditions are changed by mining activities or abnormal weather events.

The Mine dewatering system consists of sumps, fishtanks, and air and electric pumps through steel mains dewatering pipelines to the surface. The design considers a worst case total water make of 26 l/s comprising the following:

- expected water inflow from strata—10 l/s (estimate worst case)
- raw water consumption—16 l/s
- Total water make—26 l/s.

Typical portable pumping equipment has been allowed for:

- 37kW electric pump pods (50 l/s)
- air-operated pumps (10 l/s)
- 90kW pump pods in the mains headings (50 l/s).

The settling dam to collect the underground mine water will be constructed close to the portal adjacent to Laydown Area-3. This water after suitable treatment can be used for irrigation purpose if needed.

5.7 Reticulated Services

The raw water for underground and surface use will be provided from the surface raw water dam situated near Laydown Area-1. The underground raw water system is also required to supply water for fire fighting purposes and will be connected to the fire water storage tanks at the surface.

For design purposes, the peak daily raw water consumption underground is 1.5ML per day. Average daily consumption is estimated to be 700–800 kilolitres per day. The primary supply to the underground mine will comprise of a Ø150 line down each portal access and these will draw water from the storage tanks without using a pump by placing the tanks at the appropriate site elevation with respect to the workings (in excess of 70 metres).

Underground water reticulation will be designed using ring mains wherever practical. Examples of ring mains are:

- primary lines down each drift connected at the pit bottom
- lines down the service road and conveyor road are connected at the end to form a ring main.

Branch lines (Ø150) will be taken off the ring main to supply water to all working areas of the mine. Pipelines shall typically be Victaulic style, hung from the roof.

The compressed air supply will be taken from the compressed air system on the surface near to each access portal.

- Underground compressed air reticulation will consist of two ring mains
  - one Ø150 line down each access entry and connected at the bottom to form the ring main
  - with in the mains development, created by Ø150 lines up the service road and high speed transport road connected at the far end to form the ring main.
- A 150NB line will be installed up the travel road in each main gate as required.
- Pipelines shall typically be Victaulic style, hung from the roof.
- Air supply will be 4000cfm at 1000kPa (need 700kPa at faces).

5.8 Fire Services

The proposed underground fire protection system used as a basis for this study is a system which incorporates current practices in New South Wales underground coal mines and is compliant with relevant statutory regulations. The company or the company's insurer may choose to impose additional requirements; however, any modifications must be diligently studied to ensure that such requirements would not adversely affect the reliability or maintainability of the proposed system.

The primary means of fire fighting is water provided via hydrants on raw water pipelines at spacings not exceeding 100m, and at each major equipment station. Assuming a 60m hose and a 10m spray length, full coverage will be provided for each drift, belt road, and the service road in the mains.

Crib rooms, mining and mobile equipment, fixed electrical equipment, workshops, and other areas will be fitted with fire extinguishers as per the appropriate statutory requirements or standards.

5.9 Gas Monitoring

A gas monitoring system will be designed and installed to comply with the Coal Mine Act and Regulations. Automatic gas monitoring and sampling points will be distributed throughout the mine. The system will provide for the following:

- fixed gas monitors measuring gas concentrations and explosibility that will automatically activate an alarm when dangerous gas levels or products of combustion are detected
- gas sampling that will be performed via a tube bundle to the surface installed measurement and monitoring station. This system will measure, monitor and record the levels of carbon monoxide, carbon dioxide, oxygen and methane
- information collected by the gas monitoring system will be displayed at locations readily available for the employees preparing to enter the mine
- gas monitoring for mobile equipment such as the longwall miner and continuous miners will be provided by the equipment supplier.

5.10 Miscellaneous Services

Provisions have been made in the estimate for lighting, communications systems, stone dust, diesel, concrete and ballast drop holes. These will require additional review and design development in subsequent stages of evaluation beyond this report.

5.11 Further Works

The detail design of the infrastructure facilities need to be addressed in the feasibility study stage. For this purpose of this study the requirements of the mine infrastructure with proposed locations have been identified to suit the mine design and the environmental effects causing minimal disturbance corridors.

5.12 Mine Development Schedule

The activities for the underground operations have been scheduled to include the environmental approval process, elements of the feasibility studies and the construction and the development phase.

The construction and the development phase represent the broader perspective without going into the details of the sequence of construction. The detail sequence needs to be addressed in the detailed design phase.

The schedule indicates that the development operations are likely to commence in 2011 in the Braymont seam and progress to the Jeralong and the Merriown seams in 2016 and 2026 respectively. The likely commencement of the longwall in the three seams is as indicated;

Braymont	June 2012 – May 2020
Jeralong	May 2020 – Jan 2027
Merriown	March 2027 – April 2033

The construction schedule is attached in Appendix -3.

6.0 COAL PROCESSING AND HANDLING

6.1 Introduction

Process Engineering and Technology Australia (Peat) has been engaged by WDS Consulting to provide a report on the coal quality, and provide a recommendation on process requirements. The scope of work is to carry out preliminary design and engineering and to produce process flow diagrams including costs associated with the construction and operation of the proposed CHPP facilities to an accuracy of +/-30%. Peat's recommendation on process requirements has been based on the evaluation of the relevant coal resource information outlined in section 2. The aim of the report is to provide the optimum process design giving flexibility and commercial advantage to the resource. The report describes the options evaluated and provides an outline as to why Peat considers a wash plant would be beneficial for the resource.

6.2 Scope and Deliverables

The scope and deliverables for the study are;

- Review of the available coal sample data to assess quality
- Provide reasoning for the need of a wash plant
- Provide process options
- Provide an outline design for recommended process options
- Provide construction cost estimate
- Provide operational cost estimate
- Provide Construction Timeline

The Battery limits for the CHPP part of the project evaluation report are the minus 200 mm ROM onto the ROM stockpile, the raw water delivery from the existing raw water dam, HV power to the CHPP Transformers, the product discharge chute to the product stockpiles and the rejects discharge chute to the rejects stockpile.

6.3 Coal Quality

6.3.1 General

From the reference information detailed in section 2 and provided in the reference documentation, Peat is able to provide the following process recommendations for a wash-plant at the Boggabri Mine site.

6.3.2 Coal Resource and Quality

Three potential seams (Braymont, Jeralong and Merriown) have been identified as seams that may be extracted by underground mining. It has been assumed that the extraction will be using continuous miners in conjunction with a single longwall capable of cutting from 2 meters minimum to 3.5 metres maximum. The three seams would be mined separately in sequence from the higher (Braymont), to the lower (Merriown). Generally the 3 seams that have been targeted as possible underground resources comprise bituminous coals of high energy with low ash and sulphur contents. The seams vary in thickness within the proposed mining area with the Braymont seam averaging approximately 4.9 m, the Jeralong 2.5 m, and the Merriown 2.2m. The Braymont seam contains a parting of up to 0.8 m within the proposed mining area.

The high levels of organics in the coal may lead to spontaneous combustion issues and the amount of small coal less than 2 mm may affect handling characteristics all of which must be considered further should the project develop further. The coal is not likely to be suitable as a coking coal however it may be useful as a PCI coal given its low ash / high energy characteristics. Care will need to be taken with the un-burnt carbon content.

From the data available (and assuming the DMB/DMC/Spirals processing option is installed) a yield of processed material at 1.50 SG producing 4.3 % ash product (average – range 4.0 % to 4.8 %) excluding dilution is 88 % to 91 %, the effect of dilution is an approximate 1.08% yield drop per percent of dilution. Dilution will normally be between 9% and 15% but will peak at approximately 27% (on a monthly basis) and 19.8% on an annual basis in the Braymont Seam where the 800 mm parting is mined. Minus 100 micron material will report to tailings and it is predicted to be 3 to 7 %. The shearer speed will have an effect on the fines generation with a slower speed generating less fines through attrition. The coal appears to be competent and thus lower than industry average fines generation is expected. The fines disposal system has been sized for a notionally high disposal rate as this will use less flocculent if the material settles readily and is still suitable if it does not. Generally the coal has a density of less than 1.5 with the associated ash having a density greater than 2.0.

Due to the geology of the potential seams and the assumed mining methods a de-stoning operation is recommended. This coupled with the information supplied would indicate that a number of process plant types could be considered.

6.3.3 Process Feasibility

From the information supplied a number of plant types would be suitable. The main process options recommended are detailed below, these are listed in order of preference:

- Option 1. - Dense medium bath / dense medium cyclone / spirals plant.

- Option 2. - Jig/Spirals Plant

- Option 3. - Dense medium cyclone / spirals plant.

We have detailed below the advantages and disadvantages of each option.

6.3.4 DMB/DMC/Spirals Option (Preferred Option)

The Dense Medium Bath / Dense Medium Cyclone / Spirals Plant have the highest capital cost, the best metallurgical efficiency and the most flexibility for both variability in rejects loading and product selection. It has a mid operating cost compared with the other options.

<u>Advantages</u>

- Best Metallurgical Efficiency of the three options – primarily due to the lower fines generation from less pre processing crushing and the better matching of gradients between the energy by size and density of the DMB for the coarse coal

- Does not have the ROM crushing station, approximately 30 % of the ROM is plus 50 mm and crushing this prior to processing would generate an additional 2 % to 3 % ROM slimes, which would be lost through tailings in a standard DMC/Spirals Plant.

- Has the most flexible for both variability in rejects loading and product selection of the 3 options. The greater rejects capacity of the DMB/DMC/Spirals plant (100 % of feed), compared to a DMC/Spirals Plant (40 % of feed), and is significant in the proposed operations. This option would give flexibility in mining the Braymont seam considering the seam parting of up to 800mm in places will vary the rejects loading on the plant. This option would also give flexibility in mining the Jeralong and Merriown seams as these seams are near to the minimum of the assumed longwall cutting capability in places, hence some encroachment on roof and floor should be expected.

- Mid level operating cost compared to the other options.

<u>Disadvantages</u>

- Highest Capital cost of the three options.

- Additional Bay required on the CPP building for the DMB, additional screens and the DMB product crusher. (However this is partially offset by the removal of a ROM crushing station)

6.3.5 Jig/Spirals Option

The Jig / Spirals plant is very flexible in rejects removal; however it has limited performance for density separation. It has the lowest capital and lowest operating costs. This plant would be recommended if the capital cost of a DMB/DMC/Spirals plant becomes prohibitive.

<u>Advantages</u>

- Lowest capital and operating cost of the three options.
- Better flexibility with rejects loading (100 % of feed), compared to a DMC/Spirals option (40 % of feed) however on par with the DMB/DMC/Spirals option.

<u>Disadvantages</u>

- Lack of flexibility where changes in coal feed quality or where market specification may limit the ability of the plant to produce the desired product.
- Worst Metallurgical Efficiency of the three options. – due to the lower process efficiency of water based processes over medium based processes.

6.3.6 DMB/Spirals Option

The Dense Medium Cyclone / Spirals Plant is not as efficient metallurgically as the Dense Medium Bath / Dense Medium Cyclone / Spirals Plant nor does it have the flexibility of either of the other plants for varying rejects loading however it has a lower capital cost than the Dense Medium Bath / Dense Medium Cyclone / Spirals Plant which is offset by the highest operating cost.

<u>Advantages</u>

- Better Metallurgical efficiency than the Jig/Spirals option. –although the difference is likely to be minimal as there is little near gravity material.
- Better flexibility than the Jig/Spirals option where changes in coal feed quality or where market specification may limit the ability of the plant to produce the desired product.
- Lower capital cost than a DMB/DMC/Spirals plant.

<u>Disadvantages</u>

- Highest operational cost of the three options.
- Not as efficient metallurgically as the DMB/DMC/Spirals option and expected to have a lower total yield than the Jig / Spirals plant due to the additional slimes generation by the increased pre processing crushing.
- The lowest rejects handling capacity of the three options (40 % of feed).

6.4 Proposed Plant Description - DMB/DMC/Spirals Plant

The proposed DMB / DMC / Spiral plant shown (see Drawings 6.1 and 6.2) is the recommended plant configuration.

6.4.1 ROM Coal

ROM from the underground mine will be deposited onto a stockpile and drawn down through three vibrating feeders. The stockpile will be managed using dozers to push out and reclaim. The reclaim rate will be controlled via a feedback from the belt weightometer to control the vibratory feeders. The reclaimed ROM will be transported via a conveyor to a surge bin (250t) with a single feeder to feed the CPP feed conveyor with the rate controlled via a feedback loop from a belt weightometer.

6.4.2 Coal Preparation Plant

The minus 200 mm ROM is screened at 12 mm on the raw coal screen with the plus 12 mm being fed into a dense medium bath. The bath reject is rinsed before dropping onto the reject conveyor. The bath product undergoes both draining on a static screen and rinsing on a vibrating screen before it is crushed to minus 50mm. The minus 12 mm ROM is deslimed at 0.5mm with the minus 0.5 mm gravitating to the desliming cyclone feed sump. The plus 1.0 mm is mixed with correct medium and pumped into a single 800 mm diameter DMC with the floats and the sinks both traveling over drain and rinse screens for medium recovery prior to centrifuging and dropping onto the discharge conveyors.

Both the DMB and DMC circuits share a common dilute circuit and have separate correct medium sumps. Magnetite addition is via a common floor reclaim circuit with the make up magnetic separator concentrate being directed to either of the correct medium sumps.
The minus 0.5 mm material is pumped to the desliming cyclones where a classification occurs at 100 microns. The cyclone overflow goes to the thickener and the cyclone underflow is fed to the spirals. The spirals separate the fine product from the fine reject with the product being thickened in hydrocyclones before centrifuging and the reject joining the desliming cyclone overflow as thickener feed.

The thickener underflow is dewatered using belt press filters then conveyed with the small coal (DMC) circuit reject to a stockpile for later emplacement.

6.4.3 Product Coal

The product coal is conveyed via a product transfer station to a skyline tripper for discharge onto the product stockpiles.

6.4.4 Rejects

The rejects will be de-watered on belt press filters and conveyed onto an open stockpile from which they are reclaimed and transported to the emplacement area where they are emplaced.

6.4.5 Electrical

Electrical control and instrumentation has not been designed or estimated in detail. We have used an industry indicator for a typical CHPP as a percentage of the total project cost.

6.5 Risks and Opportunities

6.5.1 Risks

The primary process risk is that at times a large quantity of rock will be present in the ROM (for example from a roof fall), the DMB option mitigates around this as it has a full capacity reject capability. As both the coal and the dilution material are competent, the use of differential breakage characteristics such as a rotary breaker is not appropriate. The estimated yields and product specifications are subject to both the geology and the mining techniques used and as there is minimal information these estimates should be treated as preliminary until better resource definition and mining design has been obtained.

6.5.2 Opportunities

The opportunity to carry out a cost benefit study on process options would be appropriate when resource definition and mining design has been obtained.

6.6 CHPP Capex and Opex Estimate

The following details provide the basis of estimate of the anticipated Capital and Operating costs for the 4 Mtpa plant proposed in section 6.4.

6.6.1 Capital Costs +/- 30 %

The project capital is discussed in more detail in Section 7 – Economic Evaluation, the following table summarises the processing facility costs.

Table 6.1

Description	Cost
Coal Preparation Plant	$31,918,469.00
Electrical and Instrumentation	$5,152,856.00
Materials Handling	$11,022,000.00
Indirect Costs	$7,700,000.00
Total (AUD)	**$55,793,325.00**

6.6.2 Exclusions/Assumptions

The following is a list of items that haven't been included in the above capital estimate.

- Excludes all taxes, import duties, GST and any specific government and local charges.
- Excludes provision of an HV electrical supply.
- Excludes any bonds, insurances and finance costs.
- Excludes site preparation and all earthworks.
- Excludes environmental protection costs and site wide drainage.
- Assumes construction accommodation and messing facilities are provided by others.
- Excludes provision of water and power for construction and operation.
- Excludes all local building regulation and engineering construction licenses.
- Excludes permanent installation of CHPP Offices, amenities and workshops.
- Excludes any Roading Infrastructure

6.6.3 Operating Costs

The project operating costs are discussed in more detail in Section 7 – Economic Evaluation, the following table summarises the processing facility operating costs.

Table 6.2

Description	Cost (AUD $/ROMt)
Operating Manpower	0.58 (approx)
Consumables	0.35
Operating Power	0.29
Mobile Equipment Operation	0.68
Reject Disposal	0.76
Repairs and Maintenance (Materials)	0.69
Total (AUD $/ROM t)	**3.35**

A number of factors will influence this figure including both resource related, mining related and CPP plant capital / operational configuration.

6.7 Timescale

A construction schedule for the project based on a November 2009 start date was developed. (refer Appendix 3: Construction Schedule) To make allowance for further detailed evaluations and design work will be completed prior to further progression of the project. The Construction schedule has been modified to reflect a start date of the 1st of November 2010 after consultation with WDS. Revised Milestone dates are listed below.

Table 6.3

Key Study Milestones	Forecast Completion Date
Award of New CHPP Project	1st November 2010
PFD Issued for Construction	31st December 2010
Mechanical Engineering Design	31st March 2011
Civil Engineering Design	30th April 2011
Electrical Engineering Design	31st April 2011
Major Equipment Procurement	31st May 2011
Construction	30th December 2011
Commissioning	31st January 2012

7.0 ECONOMIC EVALUATION

7.1 Modeling Description and Assumptions

7.1.1 Estimate Basis

At the request of Idemitsu, a full financial analysis was not within our deliverable scope. Our primary financial deliverables, listed below, are to be integrated into Idemitsu cost models for internal economic analysis.

- Capital Expenditure Estimate
- Annual Operating Cost estimate
- Indication of likely depreciation lives of major assets.

The estimates provided are consistent with the requirements of a conceptual study, approximately ±30% for capital, operating costs, and sustaining capital. Attached in Appendix 1 is the Study Standards applied for this conceptual study. The majority of estimate is to be sourced from either a databank, factorised, or benchmarked.

Both the capital cost estimate and the operating cost estimate were developed primarily from the WDS Consulting data base. Through our extensive experience with constructing cost estimates for previous conceptual, pre-feasibility, feasibility studies and detailed designs we have developed an internal data base which provides estimates within the accuracy of this study.

Where data base estimates are over 12 months old we have attempted to source more recent data, if not obtainable within the time frame of the study we have applied approximate escalation rates and factored available data accordingly.

Final estimates were compared against known industry bench marks, of similar mines with similar production capabilities and work force.

The capital and operating cost estimates presented herein are within the level of accuracy and level of engineering required for this conceptual design study.

7.1.2 Description of Basis

The operating cost model has been developed, based on a combination of first principal calculations and experience based assumptions, which allocates costs on either a variable or fixed basis.

The Capital estimate model includes all expenditures to develop the underground and surface infrastructure. Costs have been spread between 2010 and 2015 allowing for mine construction, development, production ramp up and expansion. Sustaining capital has been included in the annual operating cost estimates.

7.1.3 Base Date

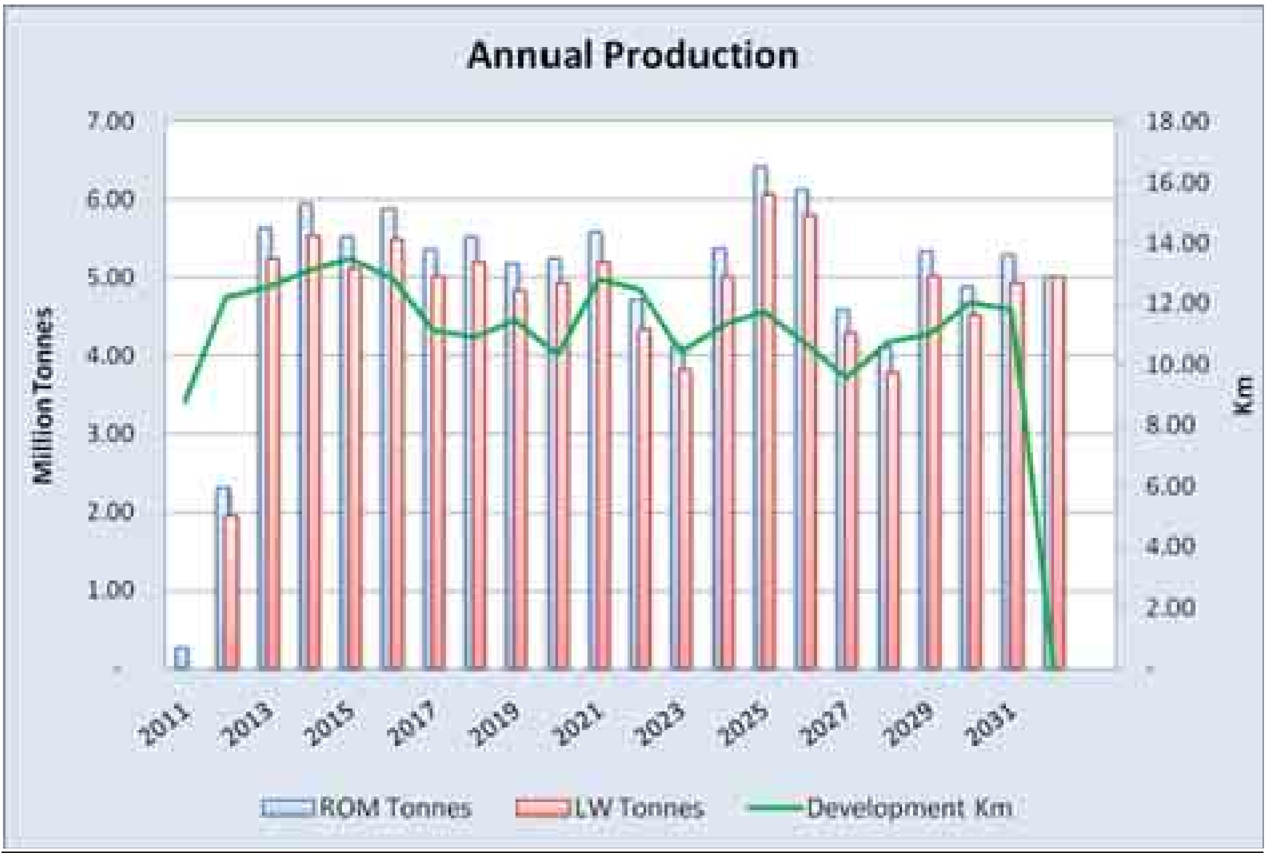
The underground and surface operations operating estimates have been compiled in mid year 2009 dollars. All costs, both operating and capital are in Australian dollars.

No escalation or inflation has been allowed for in the modeling.

7.1.4 Production Inputs

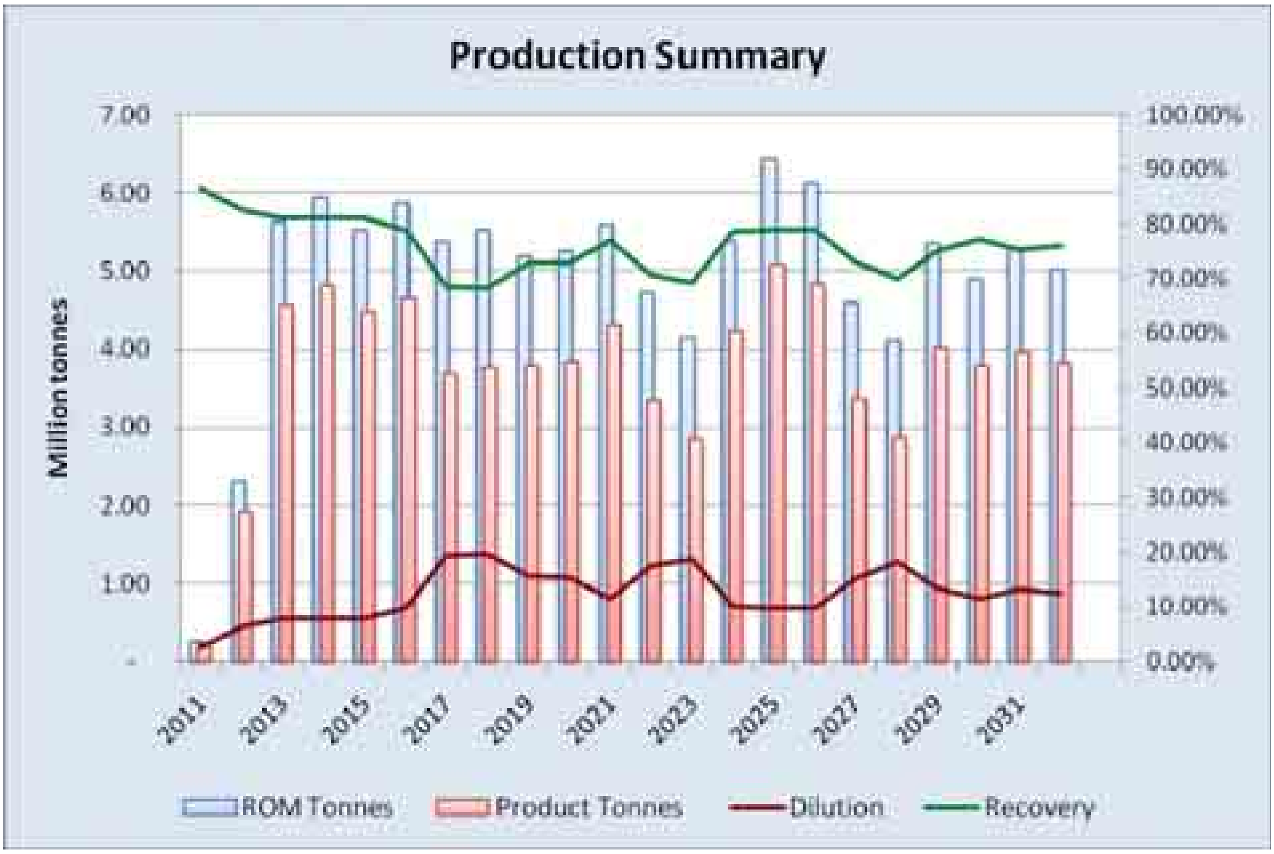
As described in section 4.0 Mine Design, the annual mine production is to commence is 2011 with initial development drivage. Development of mains and gate roads increases into 2012 when initial Longwall production commences. The following graph, Figure 7.1, shows the annual production profile. Longwall production ranges between 4 and 6Mtpa with average annual production approximately 5.0Mtpa. Development rates range between 9.5 and 13km per year.

Figure 7.1 Annual Production



Total run of mine production ranges between 4.1 and 6.4Mtpa, with average annual production of approximately 5.3Mtpa. With high volumes of dilution averaging 12.80% of the ROM product per year and peaking at 19.8% the resulting product recovery is moderate ranging between 68% and 86% per annum. Figure 7.2 summarise the annual production figures. Annual Product tonnes (Free on Rail) range between 5.0 and 2.8Mtpa with average production of approximately 4.0Mtpa when operating at full production.

Figure 7.2 Production Summary



7.2 Operating Costs

7.2.1 Labour

The labour requirements for the Boggabri underground are based on the roster structure and the number of operators, supervisors and tradesman per crew. It has been assumed for this high level study that the longwall and development crews will operate on an equal time roster, of 7 on 7 off, working 10 hours shifts.

The outbye support crews will be made up of equipment maintainers (electricians and diesel fitters), miners to construct ventilation control device and install secondary support, and personnel to install, maintain and remove conveyors. Outbye crews will work a range of either 7 on 7 off rosters or a 5 day per week (Monday to Friday) roster. A total of 204 full time underground employees will be required, the following table summarises operator requirements. In addition to these base requirements contractors will be utilised where required. This includes specialist contractors for longwall moves, significant secondary support and major ventilation structures. These operators have been included in the unit costs in the operating cost model.

Surface staff requirements for Boggabri underground are 40 full time employees. The majority of these employees will work a normal Monday to Friday, 5 day per week roster, 10 hours per day. Development and Longwall coordinators will be required to work a 7 on 7 off roster to provide full time production management.

Table 7.1 Staff and Surface Labour

	Total numbers
Mine Management	2
Administration	4
Technical Services	8
Development	8
Longwall	7
Outbye & Projects	7
Control Room	4
CHPP	19
TOTAL	**59**

Table 7.2 Underground Labour

	Rotation 1	Rotation 2	Rotation 3	Rotation 4
Longwall	**7 on 7 off – 10 hour shift**			
Deputy	1	1	1	1
Face Crew	5	5	5	5
Tradesman	2	2	2	2
General & Outbye	2	2	2	2
Absentee & Leave Allowance	20%	20%	20%	20%
Development (2CM's)	**7 on 7 off - 10 hour shift**			
Deputy	2	2	2	2
Face Crew	10	10	10	10
Tradesman	4	4	4	4
General & Outbye	4	4	4	4
Absentee & Leave Allowance	20%	20%	20%	20%
Outbye	**5 Day - 10 hour shift**			
Deputies	3			
Maintenance & Conveyors	13			
Outbye	**7 on 7 off - 10 hour shift**			
Deputies	2	2	2	2
Ventilation & Secondary support	3	3	3	3
Conveyors, pumps, other	5	5	5	5
Absentee & Leave Allowance	10%	10%	10%	10%
Sub-Total	63	47	47	47
TOTAL	**204**			

7.2.2 Operating Cost Inputs

The majority of the operating costs have been developed from a first principals basis. For example the number of roof bolts based on development rates per year and the average roof and rib bolting pattern, in addition to meshing requirements and secondary support. Unit prices for each consumable were obtained from our data base.

The operating costs allow for major rebuilds of all major equipment. These rebuilds have been included as a $/tonne for the particular equipment.

Operating costs have been summarised and provided based on either $/development meter, $/development tonne, $/longwall tonne, $/longwall meters of retreat, $/longwall move, $/annum and $/ROM tonne. Table 7.3 provides the summary of the unit operating costs for the mine, and coal handling and processing. The total operating costs for Mining and process are summarised in Table 7.4.

An allowance of $1.50 per ROM tonne has been included for sustaining capital. This is considered sufficient for expansion into the Jeralong and Merriown seams and for equipment replacements of outbye and miscellaneous equipment as required.

Costs included in this estimate go up to and include the truck load out. We have not considered the product coal overland haulage or train load out costs.

Table 7.3 Unit Operating Cost Summary

Development			
	Roof Support	12.49	$/development t
	Ventilation	4.82	$/development t
	Consumables	1.68	$/development t
	Maintenance	5.21	$/development t
	Labour	16.25	$M/annum
Longwall			
	Ventilation	0.26	$/LW t
	LW Move	4.50	$M/LW move
	Consumables	0.43	$/LW t
	Maintenance	3.11	$/LW t
	Labour	8.11	$M/annum
Outbye & Overheads			
	Diesel Equipment	4.68	$M/annum
	Ventilation & Gas	1.25	$M/annum
	Dewatering, Stone Dust and Roads	2.25	$M/annum
	Surface Conveyors & Reclamation	1.50	$M/annum
	Training, G&A, Insurance	8.00	$M/annum

*Contd…..*Table 7.3 Unit Operating		
Staff Labour	6.76	$M/annum
Sustaining Capital	1.50	$/ROM t
Washing & Handling		
Consumables	0.35	$/ROM t
Power	0.29	$/ROM t
Mobile Equipment	0.68	$/ROM t
Repairs & Maintenance	0.69	$/ROM t
Reject Disposal	0.76	$/ROM t
Labour	3.21	$M/annum

Table 7.4 Summary Operating Costs

Summarised Operating Costs		
Development	$/Dev m	2232.43
Longwall	$/LW t	8.27
Overheads	$/ROM t	8.48
Mining Cost	**$/ROM t**	**21.15**
Washing Cost	$/ROM t	3.42
Total Cost	**$/ROM t**	**24.28**
TOTAL COST*	**$/Prod t**	**32.47**

*Delivered to Truck Haulage Stockpile

The annual operating costs have been summarised graphically in Figures 7.3 and 7.4. Annual ROM mining operating costs including the first year of ramp up production is $21.15/ROMt, once full production is achieved in 2013 the annual operating cost averages approximately $20.33/ROM tonne.

Figure 7.3 Mining Operating Costs $/ROMt

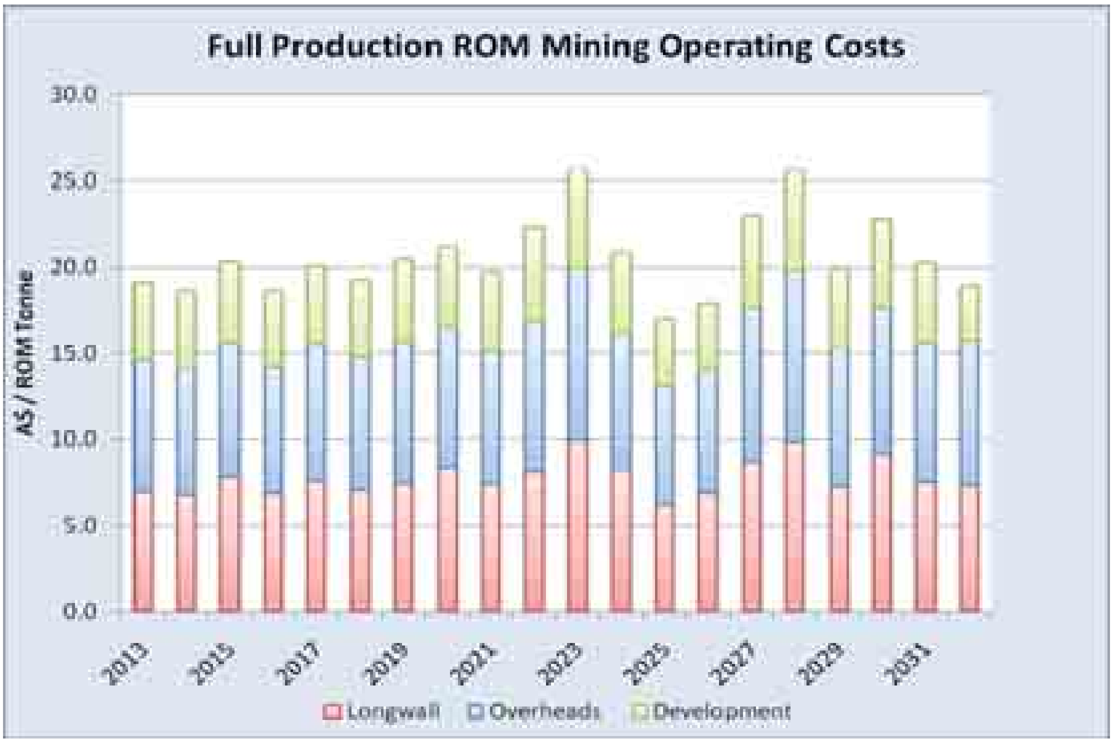


Figure 7.4 Total Annual FOR Operating Costs $M

7.3 Capital Costs

The purpose of the capital estimate at this stage of the study is to develop the capital cost to a nominal accuracy of +/- 30% for a conceptual study level design. The capital cost estimate will be used as an input to the financial modeling analysis.

Capital costs for the Boggabri underground have been determined for an underground longwall mine utilising top coal caving, two development unit and supporting surface infrastructure facilities with an average annual production rate of 5.3 Mtpa.

7.3.1 Assumptions

The estimate has been based on the following underlying assumptions:

- The surface elements of the project are to be delivered by a standard engineering, procurement and construction management (EPCM) approach using a head contractor acting as agent for the owner.
- The underground construction will initially be a contracted activity which will transition to the owner as the mine ramps up.
- Design and construction activities will proceed generally in accordance with the implementation schedule described in this report.
- Surface construction will generally occur on a single shift basis with no interruptions from industrial, political or other civil causes.
- Underground construction will be a 24-hour, seven-day operation.
- Construction award rates and conditions are currently volatile. The estimate is based on rates developed from recent projects.

7.3.2 Exclusions

The following items are specifically excluded from the estimate:

- Any works associated with the rail load-out or overland transport of the product coal from the truck load out.
- Any accommodation or infrastructure improvements to the town of Boggabri
- Overseas equipment inspections
- EIS and approvals process
- Mine rehabilitation
- Pit pre-production development including stripping waste stockpiles and shaping
- Goods and services tax (GST)

7.3.3 Capital Breakdown

Estimate details were quantified and costed as outlined below.

Exploration and Feasibility

- Allowance for exploration drilling, quality testing and feasibility study to get design and estimate to ±10% accuracy

Mine portal

- Includes a provision for installation of the mine entry portals and associated earthworks

Heading development

- An allowance has been made for capital costs for the initial portal drivage and pit bottom establishment.

Pre Longwall production capitalisation

- An allowance for a contractor to drive the mains whilst Boggabri development units drive the gate roads. This is required to build up sufficient development float.

Ventilation

- Includes procurement and installation of the main fan
- Ventilation stoppings, overcasts and doors

Underground ancillary and support vehicles

- Includes purchase and commissioning of eight LHD vehicles and associated attachments
- Personnel carriers and trailers
- Grader for miscellaneous works
- 18 Diesel vehicles in total and required attachments and trailers

Underground conveyors

- Underground conveying system with a capacity of 6,000 t/hr; includes three development conveyors, two longwall conveyors, one main trunk conveyor and ancillary equipment.

Development equipment

- Includes two continuous miners, four shuttle cars and associated equipment
- High voltage cabling, communication equipment and face equipment

Longwall equipment

- Includes 250 m Longwall top coal caving face with a maximum working height of 3.5 m to a minimum working height of 2.0 m
- One set of longwall shields and two sets of the remaining longwall equipment (shearer, AFC, BSL, electrics etc.)

Underground services

- Includes provisions for reticulation of raw water
- Dewatering pipe work and associated pumps
- Compressed air reticulation valving and supports
- Electrical reticulation, communications system and environmental monitoring

Underground mine consumables

- Includes allocation of miscellaneous tools for project start-up

Underground ROM & Surface Coal Handling

- Includes a conical 18,000 tonne stockpile able to be dozed or spread to 150,000 tonne maximum capacity. Includes 18m high gantry and stacker off the UG feed belt.
- Includes an underground reclaimer fed by 3 vibratory feeders which will feed the overland conveyor at 2,500tph. This will directly feed the CHPP surge bin.
- Also includes surface equipment including dozers and servicing trucks

Conveying overland

- Includes the 2.6km of surface overland conveyors, including the trunk belt to the ROM stockpile and conveyor from the UG ROM stockpile reclaimer to the CHPP surge bin. The conveyor will operate at 2,500 tph.

Power supply and distribution

- Includes 66 kV high tension power line feed
- UG mine and CHPP area 66 kV substation including 66 kV/11 kV transformers in the switchyard, plus one 2 MVA emergency diesel generator
- Includes 66 kV/22 kV transformer feeding CHPP substations and four 22 kV/0.413 kV substations feeding CPP and surface coal handling conveyors
- Also includes site reticulation of power to fans, portals and underground dropper holes.

Water and wastewater reticulation & Equipment

- Includes an allowance for the Raw water system pumping and piping for raw water from clear water dam and piping from river as required.
- Potable water system
- Fire protection for permanent works
- Sewage treatment system
- Pumps and piping for raw water from ROM stockpile catch dam, streams plus return water from slimes dam
- Other surface equipment for dewatering, sump construction and clean up.

Industrial Area and CHPP

- As detailed in chapter 6 of this report, includes DMB, DMC and spiral plants.
- Includes administration building, workshops building including maintenance equipment, crib room building, warehouse building, bath house building and first aid facility

Control and communications systems

- Includes the costs associated with setting up a communication system within the new facilities and integrating it with the mine's current system. It includes an internal phone network, use of radios and loudspeakers. Main control system hardware and software is included in the CPP estimate.

Haul and site roads

- An allowance for new conveyor corridor, haul roads, access roads to and from the Mine office infrastructure areas, and access to the fan and UG mine infrastructure areas.

Mobile Equipment

- Mobile surface equipment including trucks, four wheel drives, fork lifts, cranes, and bobcats.

Spares and First Fills

- First fill for all major consumables for both surface and underground use. Also includes major spares for critical equipment.

Commercial

- Allowance for legals, insurance and government fees.

Project Management

- Allowance for owners project team to manage the construction and EPCM contractor

EPCM contractor

- An EPCM contractor will be responsible for the detailed design and major construction packages delivery. An allowance of 15% of the total estimate, prior to contingency, has been made.

Contingency

- At this stage of the study we have assumed a generic across the board contingency of 25% is suitable for the estimate. This is in line with the level of engineering, design and cost estimation process conducted.

7.3.4 Capital Expenditure Results

The total estimated cost of the project to the operational phase is $A787.6 million, at June 2009 dollars (excluding GST and escalation). A summary of the capital cost by major cost area is given in Table 7.5

Table 7.5 Itemised Capital Breakdown

Description	Capital Expenditure AU$
Feasibility and Exploration	15,000,000
Portal	1,542,543
Heading Development	2,159,561
Pre LW production capitalisation	42,000,000
Ventilation	6,687,500
UG Ancillary Equipment and Support Vehicles	15,488,677
UG Conveyors	88,060,000
Development Equipment	29,878,438
Longwall Equipment	149,000,000
UG Services	12,174,466
Mine Consumables	617,017
Underground ROM & Surface coal Handling	22,022,000
Conveying Overland	23,500,000
Power Supply and Distribution	16,166,864
Water and Waste System Reticulation & Equipment	15,085,087
Industrial Area and CHPP	49,618,469
Control and Communications Systems	3,552,181
Haul and Site Roads	7,268,149
Mobile Equipment	6,428,343
Contractor Indirect	6,170,173
Spares and First Fills	10,797,803
Commercial - Insurance / Legal / Gov and Fees	11,130,000
Maintenance Management	1,831,770
Project Management	23,145,862
EPCM	69,932,591
Contingency @25%	157,314,374
TOTAL	**786,571,868**

The mining schedule assumes development drivage will commence in 2011, followed by longwall production in mid 2012. To fit in with this very tight construction and development schedule capital expenditure will need to commence immediately with additional exploration and feasibility studies. The first 84% or A$660.7M will be spent between 2011 and 2013. Capital expenditure for the project construction will be completed by 2015. Figure 7.5 and table 7.6 summarise the capital expenditure by year.

Figure 7.5 Annual Capital Expenditure

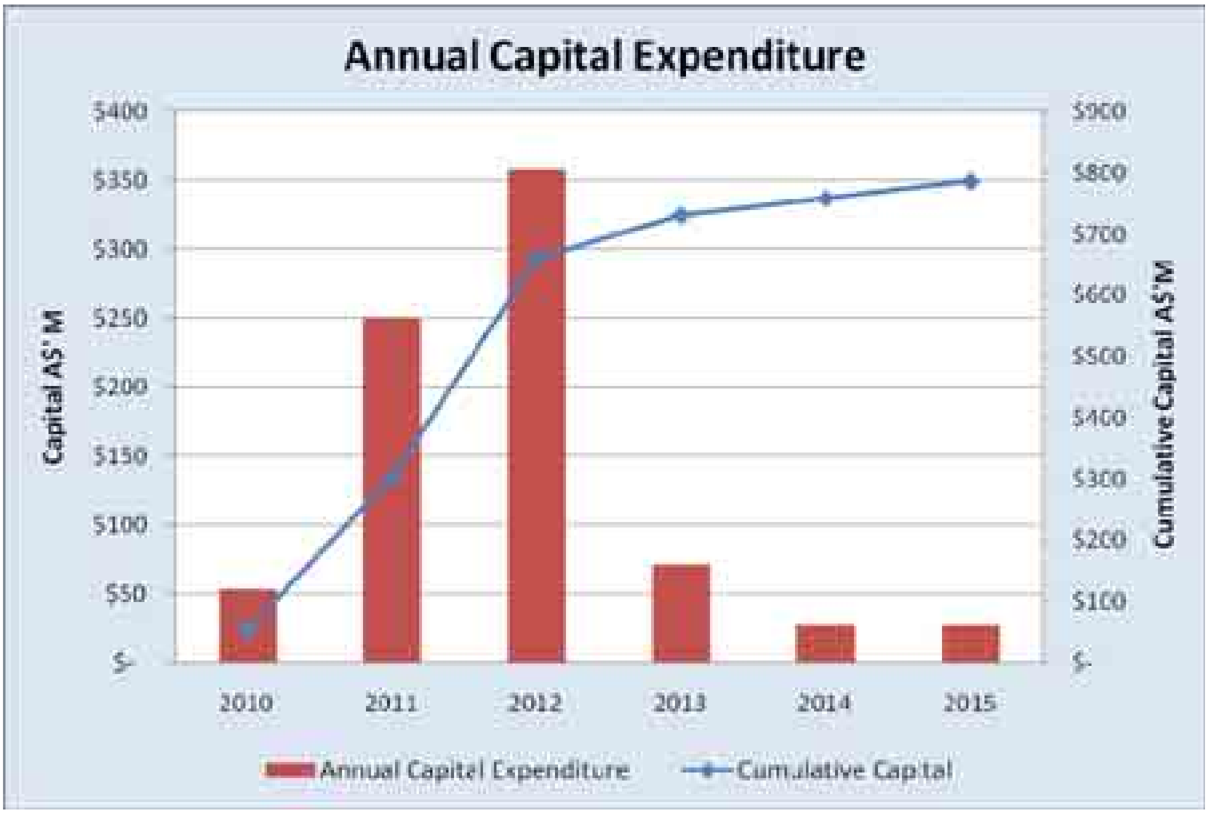


Table 7.6 Boggabri Capital Expenditure

	2010	2011	2012	2013	2014	2015
Exploration & Design	31.5	-	-	-	-	-
Underground Construction	2.1	19.5	20.2	14.7	-	-
Underground Infrastructure	0.0	23.3	33.5	22.3	22.0	22.0
Mining Equipment	6.0	38.8	119.2	14.9	-	-
Surface Infrastructure	-	71.2	71.7	0.8	-	-
Commercial	-	2.8	7.8	0.6	-	-
Construction & Management	2.3	42.1	32.9	3.5	-	-
Contingency	10.5	50.4	70.1	12.9	3.1	3.1
Total	53.6	249.4	357.7	70.8	27.5	27.5

7.3.5 Depreciation Summary

At Idemitsu's requested WDS Consulting did not perform any economic analysis or financial evaluations we have included the following table to assist with their internal evaluations. Table 7.7 provides approximate depreciation lives for each of the major cost elements of the project. These depreciation lives can be used to estimate the depreciation schedule for tax adjustments in their cash flow analysis.

Table 7.7 Depreciation Lives

Description	Asset Depreciable Life*
Feasibility and Exploration	20
Portal	5
Heading Development	5
Pre LW production capitalisation	5
Ventilation	12
UG Ancillary Equipment and Support Vehicles	8
UG Conveyors	10
Development Equipment	8
Longwall Equipment	10
UG Services	5
Mine Consumables	1
Underground ROM	20
Conveying Overland	12
Surface Coal Handling	20
Power Supply and Distribution	20
Water and Waste System Reticulation	20
Industrial Area and CHPP	20
Control and Communications Systems	5
Haul and Site Roads	5
Mobile Equipment	5
Contractor Indirect	5
Spares and First Fills	1
Commercial - Insurance / Legal / Gov and	1
Maintenance Management	5
Project Management	5
EPCM	5
Contingency @25%	10

*Note: Depreciation lives are indicative and taxation advice should be sort to confirm

8.0 HEALTH, SAFETY, ENVIRONMENT AND COMMUNITY

8.1 Introduction

Idemitsu Australia Group Occupational Health, Safety and Environmental policy sets out the environmental and safety commitments and system requirements for all its activities. This policy has been applied to Boggabri through a detailed impact assessment approach.

8.2 Environmental Studies and Assessment – Current Operations

The environmental studies and assessments for the current project have been undertaken to meet the legislative requirements of an environmental authority under the NSW Environmental Planning & Assessment Act (EP&A Act). The existing mine was approved by the Minister of Planning in August 1989 (DA 79/1443) to extract 5 million tones per anum (Mtpa) of product coal for a period of 21 years from the date of grant of the mining lease. This consent was granted up to 15th November 2011.

However the mining capacity under this consent during the last three years has only been about 1.5Mtpa and subsequently Boggabri Coal has submitted an application to the Department to modify development consent DA79/1443 under section 96(1A) of the EP&A Act on 26th February 2009. The application covers the following components;

- Implementation of mine water irrigation scheme, including an additional 100 megalitre (ML) mine water storage dam in the foot print of an originally approved (but not yet constructed) 300ML capacity tailings dam
- alterations to the overburden emplacement area (OEA);
- realignment of a clean water diversion dam and drainage lines; and
- an additional storage shed

The department has observed that with the present mining operations and without a CPP, the mine site has surplus mine water. It is therefore proposed to construct a water storage dam of 100ML capacity which could accommodate three consecutive years of wet weather conditions. This mine water will be treated and used for irrigation purpose.

The final landform is also proposed to be modified by changing the shape of the OEA so as to reduce its footprint. The clean water diversion dam and drainage system would also be modified to align with the new shape of the OEA. This will also result in the retention of approximately 27.5 hectares (ha) of Leard State Forest vegetation in the south east corner of the site which as per the existing consent allows for the clearing of the vegetation and emplacement of overburden materials in this location.

A shed for the storage of the projects geological core samples is also proposed to be constructed adjacent to the existing hay shed near the Nagero Homestead.

8.2.1 Statutory Context

The department has assessed the merits of the application and is satisfied that the current mining operations would have minimal environmental impacts as;

- The rate of coal production is not being increased
- Would involve relatively minor construction activities which are ancillary to the coal mine itself
- Would lessen the impacts of the mine as it was originally approved

However, the application for approval is subject to complying with the conditions of consent which include developing an" Irrigation Management Plan" based on concerns raised by the Department of Primary Industries (DPI) and the Department of Environment and Climate Change (DECC) regarding the sodicity of the soil and "Aboriginal Cultural Heritage Management Plan".

8.2.2 Cultural Heritage

There is potential for sub-surface Aboriginal items in the region. Boggabri Coal has made an application to DECC under section 87 of the National Parks and Wildlife Act 12974 to conduct a sub-surface investigation. In view of this the Department has recommended a condition of consent requiring the implementation of Aboriginal Cultural Heritage Management Plan to ensure that appropriate procedures are followed to protect Aboriginal heritage.

8.2.3 Flora and Fauna

The Department is satisfied that no threatened species, populations or ecological communities were identified and in general the site is considered to have low ecological value.

8.2.4 Noise

The Department is satisfied that the noise impacts resulting from the construction of the water dam (MD3) is limited. Existing noise monitoring procedures are considered satisfactory for monitoring cumulative noise impacts.

8.2.5 Visual Impact

The construction of the dam is consistent with the surrounding land use and the Department is satisfied that the visual impacts of the MD3 would be minimal.

8.3 Impact of Underground Mining on the Environment

The environmental impact on the recovery of the target resource area by underground mining methods will require environmental studies to be undertaken and Environmental assessment report compiled. The purpose of the environmental assessment report is to present in full the results of the studies, including study methodologies, data and fieldwork, which form the basis for describing environmental values, predicting potential impacts and developing appropriate industry standard mitigation measures. The EIS provides a detailed assessment of the key issues and provides mitigation and management measures where necessary. A summary of the key environmental issues is provided below.

8.3.1 Land Usage

The environmental impact on land usage over the lease area will be significantly less compared to open cut operations. Further the area for Overburden Emplacement Area will no longer be required except for excavations to provide access to commission possible ventilation shafts and the material excavated during the shaft construction. The underground operations will create a disturbance corridor in the Southern part of the lease area which will have the overland conveyor, Access road and the Power line traversing through the area. Standard drainage and environmental controls will need to be integrated into the design of these facilities.

Further the landform of the Overburden Emplacement Area will have to be modified and the area around the conveyor and the access road will need to be cleared and relocated to the Eastern side. Please refer to drawing 4.17 & 4.18 for details. Table 8.1 below indicates the disturbance corridor created due to the various surface infrastructures;

Table 8.1 Disturbance Corridors

Infrastructure	**Location**
Shaft and Ventilation Fans	Northern part of the lease area
Overland Conveyor, Access road, and Power lines	In the southern part of the lease area
Lay down area-1& 2	In the southern part of the lease area
Laydown area -3	Close to the Portal entry-Northern part of the lease.
Refueling area	In the southern part of the lease area
Admin building, workshop, bathhouse ect	In the existing bench of the opencut operations
Landform of the OEA	Towards the Eastern part of the present OEA

Due to underground operations there will be some effects of subsidence which needs to be analyzed and mitigation strategy developed. This will need a detailed subsidence study to be carried out and a subsidence management plan developed to mitigate the effects of subsidence. With the superimposition of the workings over the three target seams, up to 12m of coal can be excavated in areas. The thick and strong roof strata above those seams will reduce the overall subsidence profile. This will require further detailed studies to further define the actual impact on the surface.

8.3.2 Surface Water

The EIS for surface water impacts by the underground operations will need to be analysed as the impact of subsidence effects, if any could change the directions of the water creeks over the lease area. The potential effects of subsidence on surface drainage include initiation of localized erosion, and alteration of surface drainage paths.

8.3.3 Groundwater

The assessment of the effects on ground water due to underground mining operations will need to be carried out to assess the impacts of subsidence and disturbance to the aquifers due to the mining activity. Proper measures need to be adopted to prevent the contamination of the ground water with the mine water. The provisions for ground water management in the existing Environmental approval for the current opencut operations will apply to the underground operations as well.

8.3.4 Flora and Fauna

In general the site is considered to have a low ecological value as mentioned in the 'Boggabri Coal Mine EA Approval'. However a detailed assessment of the effects of subsidence due to underground mining on the flora and fauna needs to be done. Subsidence itself does not cause the loss of vegetation, subsidence may, however, cause surface cracking and ponding, which could potentially affect flora and fauna. Monitoring of subsidised area if any should be conducted periodically during the period of active subsidence. The impact of underground mining on the flora and fauna will be relatively less as compared to opencut mining.

8.3.5 Cultural Heritage

The areas with the cultural heritage identified in the approved EIA plan for the present opencut operations will also be applicable to the conceptual underground operations as well. However a detailed study needs to be carried out to understand the impact of the underground operations on areas with cultural heritage and necessary mitigation strategy implemented by developing a Cultural Heritage Management Plan.

8.3.6 Hazardous or Contaminated Waste Management

A waste management plan needs to be in place to deal with hazardous or contaminated wastes. There are a number of potential sources of land contamination including:

- Vehicle and plant maintenance operation
- Refueling operations including storage
- Tyres
- Chemical spillage
- Disposal of waste material
- Sewage treatment

8.3.7 Land Rehabilitation

The area to be subsided by underground mining will be monitored and rehabilitated as necessary. Rehabilitation will include installation of remedial drainage works, erosion and sediment control work and repair of surface cracking. A mine rehabilitation plan will be prepared to address the mitigation strategy for land rehabilitation.

8.3.8 Additional Environmental Issues

The following additional environmental issues should also be considered for underground mining;

- Traffic
- Mine water management
- Air quality
- Noise
- Scenic values/visual impact
- Socioeconomic impacts

Mining this area by underground methods rather than open-cut methods will significantly reduce the environmental impacts of mining as it will reduce the extent of ground disturbance. EPA approval for underground mining will be necessary as the environmental impact of underground mining in this area has not yet been subject to detailed assessment. It is envisaged that apart from

Infrastructure placement, little of the area will be disturbed by underground mining operations. A proper monitoring, grievance resolution and reporting strategy will have to be in place to deal with any environmental issues raised.

Environmental Management Plan for the Boggabri Underground project will have to be developed which have auditable and measurable commitments to environmental management practices for the project. Implementation of the EMP will ensure that the underground mining and construction and operation of associated surface facilities will be undertaken in accordance with a high standard of environmental management.

9.0 RISK

Risk assessments are core to achieving safe and sustainable development. It is essential that risk assessment and management is undertaken prior to the commencement of mining operations. Sufficient controls must be implemented to reduce the risk of unwanted events occurring. Necessary controls are identified through the use of Risk Assessment Matrices and Hazard Analysis Tables. These matrices/tables enable the likelihood and severity of identified consequences that may occur from unwanted events to be represented and weighted accordingly, in a semi-quantitative manner.

There are many risks which must be appropriately identified and mitigated before an operation can proceed. Once recognised, each risk must be controlled to an acceptable level, which states it to be of minimal concern to the operation and therefore less of a hazard to the success of the mine. If a task is deemed to have an unacceptably high risk after controls are implemented, higher levels of assessment, such as standard operating procedures, must be addressed before proceeding.

9.1 Project Risk Register

The goal of this risk assessment was to address the key or main major risks which will affect underground mining or the project at Boggabri. The risks are compiled under four headings:

- Resource definition;
- Mining;
- Environment and Community;
- Financial.

9.1.1 Risk Matrix

The following tables 9.1 & 9.2 were used to assess the consequence, probability and risk ranking of the primary project risks.

Table 9.1

ESTABLISH THE CONSEQUENCE OR SEVERITY & ASSIGN A RATING OF 1 TO 5				
CONSEQUENCE/SEVERITY (C)				
Level	**Consequence**	**Injury / Illness**	**Property Damage or Process Loss**	**Environmental Impact (e.g. hydrocarbon spills)**
1	Low	Very low level, short term injury. (Minor injury, first aid injury or report only)	Low financial loss (<$20,000)	Limited damage to minimal area of low significance
2	Minor	Reversible disability or impairment (e.g. disabling and short term lost time injuries)	Medium financial loss ($20,000 - $200,000)	Minor effects on biological or physical environment.
3	Moderate	Moderate irreversible disability or impairment (<30%)	High financial loss ($200,000 - $2M)	Moderate short term effects but not affecting eco-system
4	Major	Single fatality and/or severe irreversible disability (>30%)	Major financial loss ($2M - $20M)	Serious medium term environmental effects.
5	Critical	Multiple fatality and/or significant irreversible effects to >50 people	Extreme financial loss (>$20M)	Very serious long-term environmental impairment of eco-system.

ESTABLISH THE PROBABILITY/LIKELIHOOD OF THE EVENT & ASSIGN A RATING OF A - E			
PROBABILITY/LIKELIHOOD (P)			
A	Almost Certain	Happens Often	More than 1 event per month
B	Likely	Could easily happen	More than 1 event per year
C	Possible	Could happen and has occurred here or elsewhere	1 event per 1 to 10 years
D	Unlikely	Hasn't happened yet but could	1 event per 10 to 100 years (within a single mine life)
E	Rare	Conceivable, but only in extreme circumstances	Less than 1 event per 100 years (within [illegible]

Table 9.2

		Consequence / Severity (C)				
Likelihood / Probability (P)		1 Low	2 Minor	3 Moderate	4 Major	5 Critical
A	Almost Certain	High	High	Extreme	Extreme	Extreme
B	Likely	Moderate	High	High	Extreme	Extreme
C	Possible	Low	Moderate	High	Extreme	Extreme
D	Unlikely	Low	Low	Moderate	High	Extreme
E	Rare	Low	Low	Moderate	High	High
TOLERABLE			ALARP	ALARP	INTOLERABLE	

9.2 Risk Assessment Summary

The WDS Consulting team completed the risk assessment for this conceptual level study. The process involved determining the major risks within each of the risk categories and assessing the risk based on current controls in place. At this early stage of underground studies many of the risks were assessed as being high or extreme, this was due to the still limited exploration knowledge and the lack of controls in place.

The process was then to consider and document likely controls that will be included or considered during the study progression, construction and operations. We then reassessed the risk based on these the likely controls. The high level risk assessment is included in this chapter.

It is fundamental to a successful project outcome that these risks and others be reassessed with increased exploration knowledge and increased engineering detail.

All of the issues addressed in the risk assessment will require detailed consideration during feasibility progression. Many issues generated Moderate risks once likely controls were considered. Following the consideration of controls we believe there are one extreme risk and five high risk issues that would attention.

1. Extreme Risk – Emission Trading Scheme; a significant cost impact is very likely to have an extreme affect on project profitability
2. High Risk – Spontaneous Combustion is a significant risk for any operation however preliminary data suggests Boggabri has a high propensity to Spontaneous combustion
3. High Risk – Inrush potential as a result of subsidence induced connectivity into old workings above the mining seam.
4. High Risk – Wind Blast resulting from Goaf falls, this is considered a risk due to the massive conglomerates units in the roof.
5. High Risk – Sterilisation of reserves due to significant increases in vertical stress resulting from multi seam mining
6. High Risk – Sufficient quantity and quality of raw water for feed to underground workings and processing facilities.

	Issue	Hazard / Potential Incidents	Risk Ranking			Controls	Residual Risk Rank		
			C	P	R		C	P	R
1.0	**Resource Definition**								
1.1	Coal Quality	Product quality does not match current predicted quality assumptions.	4	D	H	Increase exploration drilling to JORC compliant reserve estimate status	2	D	L
1.2	Resource mineability	Unexpected geological structures including faults, dykes, sills, wash outs, and rolls resulting in increased dilution, reduced production rates, or sterilisation of resource areas	5	C	E	Increase exploration drilling to JORC compliant reserve estimate status including structural modelling, and formal feasibility study utilising competent personnel	3	D	M
1.3	Resource definition	In ability to interpret faulting via 3D Seismic resulting in major production delays if faulting is encountered.	4	C	E	Increase exploration drilling to JORC compliant reserve estimate status including structural modelling, and formal feasibility study utilising competent personnel, Consider 2D seismic trial during exploration programme	3	D	M
1.4	Resource definition	Resource modelling over estimates mineable reserve	3	C	H	Increase exploration drilling to JORC compliant reserve estimate	2	D	L

		due to complexity of seam splitting.				status			
1.5	Mine Design	Non optimised mine design due to lack of geological and geotechnical knowledge	4	C	E	Increased exploration, feasibility study, competent personnel.	3	D	M
2.0	**Mining**								
2.1	Strata Control	Collapse of mine workings, Loss of life,	5	B	E	Operator education and awareness Mine pillar and roadway design, design pillars to withstand mining stresses including seam interaction effects Suitable mine support systems. Suitable machinery for support installation. Mine procedures, HMP's. Inspection regimes.	3	D	M
2.2	Strata Control	Lost production due to uncontrolled collapse of mine workings	5	B	E	Model seam data, orientate mine layout to maximise recovery, consider geotechnical constraints, design each seam to avoid sterilisation of adjacent seams. Plan and schedule operations in	3	D	M

						advance, plan for continuous production, employ sufficient resources, implement regular maintenance procedures.			
2.3	Dilution	Disrupts CHPP performance, recoveries, product quality.	2	C	M	Operator education, awareness and house keeping. Competent operators. Mine pillar and roadway design. Suitable mine support design. Mine procedures. CHPP Design	1	D	L
2.4	Ventilation	Inadequate for the control of gas dust and heat, adverse effects on employee health, asphyxiation, poisoning, death, poor performance of machinery, delays to production	5	B	E	Provision of forced mine ventilation, mine ventilation design, statutory requirements, provision of auxiliary ventilation systems, gas monitoring, ventilation monitoring, inspections / surveys, vent reports, employee training and awareness, mine site procedures HMP's , back up power supply for main fans	2	D	L
2.5	Ventilation	Mine explosion due to gas and dust	5	C	E	Provision of forced mine ventilation, mine ventilation design, statutory requirements, provision of auxiliary ventilation systems, gas monitoring, ventilation monitoring,	2	D	L

						inspections / surveys, vent reports, employee training and awareness, mine site procedures , back up power supply for main fans, application of stone dust.			
2.6	Spontaneous Combustion	Fire, Explosion, Loss of life, Loss of mine, Delays to production	5	B	E	Exploration programme to include propensity testing, Operator education and awareness Mine pillar design. Mine ventilation design. Mine procedures. Gas monitoring. Inspection regimes. Sealing of abandoned workings	3	C	H
2.7	Inrush	Catastrophic loss through mining into disused or abandoned workings releasing gas and or water	5	C	E	Operator education and awareness, appropriate mine design, accurate survey control, pump out and control of water in mined out workings, no surrounding underground mines	3	E	M
2.8	Inrush / Multi Seam Workings	Unintended collapse of workings, leading to inrush of gas water or wind blast	5	C	E	Appropriate mine design, pump out and inspection of overlying workings, mine conditions expected to be dry.	4	D	H
2.9	Outburst	Burial of personnel and	4	C	E	Exploration drilling to confirm seam	2	D	L

		equipment, loss of life.				gas content. Management plans and degasification if deemed required. Low depth of cover, low expected seam gas content, lack of intrusive structures (dykes, sills)			
2.10	Windblast	Extended goaf roof hangs up behind longwall failing suddenly and releasing high energy air flow.	5	B	E	Appropriate design of longwall block width to ensure controlled cave, operator awareness and training, rules and procedures, provision of life lines & ppe. Investigate techniques to induce caving.	3	C	H
2.11	Fire	Loss of life, loss of mine, loss of equipment, major production delays, initiate mine explosion	5	C	E	Operator awareness and training, provision of adequate fire fighting capabilities, gas monitoring, procedures, appropriate conveyor and other equipment design, deluge systems, automatic suppression systems, gas filled transformers, self rescuers	2	D	L
2.12	Equipment / Machinery	Collision causing injury, equipment damage, pinch points leading to personnel injury, inadequate guarding from moving and rotating	4	C	E	Appropriate machinery design and signage, provision of adequate guarding for moving, rotating equipment and from elevated work places, provision of emergency	2	D	L

		machinery, in adequate guarding from elevated work areas.				stops, employee training and awareness, competent people, work procedures, traffic rules and signage, appropriate clothing (hi viz) and ppe, drug and alcohol policy			
2.13	Multi-Seam Mining	Sterilisation of reserves due to stresses induced by multiseam mining	4	C	E	Increased exploration and geotechnical evaluation. Appropriate mine design and equipment specification	3	C	H
2.14	Depth of Cover	Sterilisation of reserves due to insufficient depth of cover for development and longwall mining, production delays due to strata control problems caused by lack of cover	4	C	E	Increased exploration and geotechnical evaluation. Appropriate mine design and equipment specification	3	D	M
2.15	Electricity	Uncontrolled release leading to electrocution, burns, fire, initiation of explosions underground	5	C	E	Establishment of appropriate rules and procedures (isolation, cable management), statutory requirements, inspections, testing, appropriate signage, restrictions to entry of high voltage facilities, awareness and training, competent people, cpr training, appropriately designed and installed equipment	3	D	M

						and cables.			
2.16	Flooding	High rainfall events leading to uncontrolled flow of water through portal entries and surface subsidence zones	3	C	H	Provision of appropriate dewatering equipment, pumps and surface sumps. Training and procedures, TARPs for taking evasive action, competent people, inspections, rainfall and water level monitoring. Appropriate civil design for surface areas. Rehabilitation of subsidence zones.	2	D	L
2.17	Uncapped Boreholes	Loss of ventilation pressure, Unwanted airflows feeding oxidation and spontaneous combustion, animals injured or trapped.	3	D	M	Knowledge of exploration borehole history and location, program to ensure all holes capped, ability to plug holes exposed during mining so as not to affect underlying workings, sequence diagrams to show bore hole locations	2	D	L
2.18	Steel lined boreholes	Provides pathway for electrical discharge via lightning strikes to the underground workings, goaf areas, electrocution, explosion initiation	3	D	M	Knowledge of exploration borehole history and location, programme to ensure any steel casings removed from below surface level and capped.	2	D	L
3.0	**Environment and Community**								
3.1	Subsidence	Damage to native flora and	3	C	E	Increased geotechnical knowledge	3	D	M

		fauna due to excessive subsidence resulting from multi seam mining				during exploration programme and adequate mine design and panel layout,			
3.2	Subsidence	Subsidence induced draining of ground water or aquifers resulting in inability for local farmers to source ground water.	4	D	E	Increased geotechnical knowledge during exploration programme, ground water and aquifer modelling and adequate mine design and panel layout	3	E	M
3.3	Water Management	Damage to local ecosystem resulting from water run off or pumping of unprocessed water off site.	3	C	H	Monitor water quality, avoid surface water runoff into waterways, design on site water storage and recycling facilities	3	D	M
3.4	Water Management	Insufficient quantity or quality of water from local bores or river systems to maintain production	4	C	E	Project team to ensure sufficient water licenses and reliable supply of water. Designs to consider maximum recycling.	4	D	H
3.5	Air quality	Personnel and community health issues	3	C	H	Gas testing during exploration to assist with strategy. Comply by appropriate regulations and standards. Monitoring of air quality.	2	D	L
3.6	Noise	Personnel and community health issues	3	C	H	Adequate design of mine and infrastructure areas to minimise impacts of nose on local community. Consider noise attenuation where required.	2	D	L

						Comply by appropriate regulations and standards. Operator training.			
3.7	Dust	Personnel and community health issues	3	C	H	Monitor air quality levels and suppress dust. Minimise surface transport. Comply by appropriate regulations and standards. Mine is remote from local nearest residential township.	2	D	L
3.8	Emissions Trading Scheme	Increased operating cost or regulatory requirements	5	A	E	Monitor current political setting and obtain independent expert advice.	5	A	E
3.9	Housing	Insufficient housing in local community to house new employees, or community relations issues concerning increases in housing prices, and rent prices.	3	C	H	Continue with current community relations process and inform them of likely expansions and positive impacts, consider cost of constructing new housing.	2	D	L
3.10	Waste & Tailings	Damage to surrounding environment from water run off or tailings dam failure.	4	C	E	Design and construct dam in accordance with regulations, to minimise seepage and cater for adverse weather event, design water run off monitoring.	3	D	M
3.12	Access to Competent Employees	Insufficient or inadequate employees from the local community or unable to source employees to operate mine	3	C	H	Develop employment and HR strategy during feasibility process, including early employment of key personnel and experienced	3	D	M

		safely and productively				operators, family friendly rosters, fifo?			
3.13	Access to experienced Contractors	Due to proximity of the mine to other undergrounds, sourcing emergency contractors may impact production	2	C	M	Develop relationships with key contractors during feasibility and construction. Source local suppliers.	2	D	L
4.0	**Financial**								
4.1	Marketing	Product quality does not match current predicted quality assumptions.	4	D	H	Increase exploration drilling to JORC compliant reserve estimate status	2	D	L
4.2	Marketing	Inability to sell quantity of product coal due to over supply or market down turn	4	C	H	Marketing analysis of likely consumers, and expressions of interest. Idemitsu internal contacts.	3	D	M
4.3	Marketing	Inability to meet contractual obligations due to mining, processing or off site infrastructure constraints	4	C	H	Project team to commence infrastructure negotiations ASAP, mine and process engineering designs to feasibility level	3	E	M
4.4	Access to Capital	Unable to secure funding to construct mine	5	D	E	Assumed finance will be internally sort. Otherwise, knowledge of capital market conditions, have a sound and marketable project and financial plan.	3	E	M
4.5	Modelling Estimations	Financial modelling errors resulting in incorrect evaluation.	4	D	H	Feasibility study process with increased levels of engineering using competent and qualified	3	E	M

						personnel including Economist. Considerations given to likely escalation.			
4.6	Coal Price & Exchange Rates	Inadequate coal pricing assumptions resulting in over estimation of project profitability	4	C	E	Research commodity market trends, establish estimated levels of future demand, and know expected coal quality.	3	D	M
4.7	Access to Port and Rail	Project delay due to inability to secure access to infrastructure or infrastructure capacity insufficient for regional supply	4	D	H	Project owners team negotiations with rail and port providers to secure throughput. Consider alternative supply routs and ports.	3	D	M
4.8	Inaccurate Evaluation	Inaccurate OPEX & CAPEX determination	3	D	H	Feasibility study process with increased levels of engineering using competent and qualified personnel	3	E	M

Risk assessment participants:

David Boyd	(Project Lead - Senior Mining Engineer)
Todd Vallance	(Senior Mining Engineer)
Devendra Vyas	(Senior Mining Engineer)
Richard Haselwood	(Geologist)
Sean Clancy	(Student Mining Engineer)

10.0 SUMMARY

10.1 Evaluation

The Exploration Permit Tender Area #1 (EPTA) was granted to the Joint Venture participants in December 1975. The Boggabri Coal Project is a contract mine operation with open cut mining services provided by Downer EDI Mining. At present the mine produces 1.5 MT per year (ROM) of low ash thermal coal from two pits, the Jeralong pit to the north and the Merriown Pit to the south. Mining of the coal requires overburden removal operations that move 14 million BCM of spoil annually by truck and shovel operations. The mined seams vary in thickness from less than one metre to in excess of two metres.

The open cut mining operations are contracted through to 2011. This provides the interface for the establishment of underground mining operations. This has been the assumption made for the concept study. The three seams of interest to the potential underground project are (in descending stratigraphic order):

- Braymont
- Jeralong
- Merriown

The 3 seams that have been targeted as possible underground resources comprise of bituminous coals of high energy with low ash and sulphur contents. The seams vary in thickness within the proposed mining area with the Braymont seam averaging approximately 4.9 m, the Jeralong 2.5 m, and the Merriown 2.2m.

The battery limit for underground mining has been constrained by the mining lease boundary. Of the three available lease areas only CL368 and A355 have been combined for the purpose of the study and the underground mine design.

Three access options to the targeted seams where evaluated including; by boxcut, drift and by open cut highwall access. The high wall access strategy was chosen for the following reasons;

- Capital cost of boxcut and drifts options would be significantly higher than a highwall access option.
- Substantial soil excavation and stone drivage will be involved with this option
- Complex access strategy to the coal seams in view of the nature of the seam positions

- Requirement of additional disturbance of surface area for the boxcuts which is not needed in case of highwall access as it is using the existing highwall of the opencut operations.

Different methods of mining investigated included; Place Change, Wongawilli and Longwall. Several layouts were developed within the design criteria to ascertain which had the best recovery within the geotechnical limitations considered. The longwall methodology was selected in lieu of its;

- Highest reserve recovery
- Highest production rate potential
- Better strata control and inherent safety
- Most commonly applied underground method of mining in Australia

The details of the layout are addressed in Chapter 3.0 Mine Layout. Based on past research carried out in Australia and overseas on multi seam mining, the design criteria recommended that mine pillars between different levels be vertically aligned to ensure that the stress distribution is maintained within the core of pillars. The pillar sizes have been designed on the worst case scenario for depth of cover in the Merriown seam resulting in additional Factors of Safety for the overlaying seams. The seams are mined in sequence from top down to maximise the reserve recovery and mining conditions.

For the Boggabri deposit the interburden distance between the Jeralong and Braymont seams averages between 35 – 40m with some localised thinning to the south west. For the Merriown seam the interburden distance to the Jeralong is significantly less ranging on average between 15-20m with a maximum distance of 25m.

A longwall face width of 250m has been designed making allowance for; current machine technology, resource recovery, and a requirement to ensure that critical widths with regard mine subsidence are exceeded to minimise the potential hazard from wind blast.

For both Development and Longwall operation, a minimum working height of 2.0m was viewed as a good compromise given the highly variable nature of the seam thicknesses both within individual seams and between the three targeted coal seam measures.

The value is driven primarily by the specification of the longwall which must be capable of operation in all three seams. The Braymont seam is designed to be operated by Top Coal Caving Long wall method due to the greater thickness of the seam. The other two seams can be worked by conventional longwall method as the Top Coal Caving equipment is bolt on and can be removed before using in the equipment in the other two seams.

The Boggabri concept longwall mine has been designed to produce at an average rate of 5.0MT per annum (5.3MT including Development) over a 21 year period using longwall retreat methodology with the ability to Top Coal Cave.

The labour requirements for the Boggabri underground have been determined based on; the roster structure and the number of operators, supervisors and tradesman per crew. It has been assumed for this high level study that the longwall and development crews will operate on an equal time roster, of 7 on 7 off, working 10 hours shifts. The total labour requirement has been estimated at 204.

10.1.1 Operating costs

The operating costs are within the level of accuracy for the purpose of this study and based on WDS consulting database developed over our previous experience with constructing cost estimates for conceptual, pre-feasibility and feasibility studies. The estimates were also compared with the industry bench marks of similar mines with similar production capacities and work force. The unit operating cost has been worked out to A$ 31.24/FOB t.

10.1.2 Capital costs

For the purpose of this study the capital cost has been estimated to an accuracy of +/-30%. Capital costs for the Boggabri underground have been determined for an underground longwall mine utilising top coal caving, two development unit and supporting surface infrastructure facilities with an average annual production rate of 5.3 Mtpa. The total estimated cost of the project to the operational phase is $A787.6 million, at June 2009 dollars (excluding GST and escalation).

10.2 Limitations

This study has been carried out at a conceptual level which is at +/-30% accuracy. The financial figures also reflect a similar level of accuracy. The conceptual study is a desk top study based on the technical data provided by Idemitsu.

As far as the technical design is concerned, it has the following limitations:

- The Boggabri operations have three leases. However, two of the leases have the surface rights (CL368 and A355) and the third lease (A339) does not have the surface rights. The open cut operations cannot be carried out in A339 and similar limitations have been applied to the underground design as well. Greater efficiencies may be delivered by accessing further reserves in A339.
- Only the three coal seams in the opencut long term projection have been considered for the purpose of this study.
- Limited geo technical information for underground mining is available

- The presence of massive conglomerate and shallow cover of depth could be a limiting factors in caving and as well a risk potential for windblasts.
- The coal is liable to spontaneous combustion and needs a proper mitigation strategy
- Considering the present stage of the study, production activities commencing in 2011- 2012 (transition from opencut to underground) is a challenge for the delivery of this project considering the lead time for Environmental approvals, detailed feasibility study and construction period. Further transition designs between the open cut and underground may be considered.
- Multi seam working with a minimal parting between seams requires further detailed work and geotechnical inputs.
- Longwall Top Coal caving technology is presently being practiced in only one mine in Australia.
- Environmental approvals will have to obtained again for the underground operations addressing all issues having an environmental impact
- Details on the hydrology of the Boggabri deposit are limited.

10.3 Mine Optimisation

The following are ideas that could warrant further investigation to either optimise the existing concept layout or in some cases radically alter the layout.

10.3.1 Phase-1 Open Cut Mining

The concept underground mine developed in this report does not utilise any of the reserves currently planned in the Phase-1 opencut alignment up to the A339 lease boundary. There is no reason therefore why resumption of open cut mining could not occur in this zone once underground operations were completed. If an alternative underground access strategy where employed, there is no reason why opencut mining could not keep going in this alignment without stopping. Comparison between open cut and underground reserve recoveries should make allowance for the fact that these open cut reserves are still available to the WOL mine plan.

10.3.2 Orientation

The mine orientation chosen in the concept study was based on relatively little geotechnical evaluation of the coal seams themselves. This resulted in an orientation of the mine that is probably not the optimum from a resource recovery perspective. With the lease boundaries and oxidation lines generally running east-west and north- south, this would have been a preferred orientation for the mine from a resource recovery perspective. Additional research on the acceptable orientation for mining could improve recovery if it were able to straighten the mine alignment more to the cardinal directions.

10.3.3 Punch Longwall Mining

Punch Longwalling is a technique becoming more and more popular in Australia. It utilises the final highwall position(s) of completed open cuts, or in some cases the creation of purpose built boxcuts, to enable direct establishment of underground longwall gateroads off the highwall. This results in a significant saving in not having to establish main headings with all the associated add costs that goes with this. Gateroad conveyor drives can be established in daylight areas with reduced complexity and cost compared to those installed underground. The Beltana underground operation in NSW is the champion of this method in Australia and has, for many years now, come first out of all longwall operations with respect to productivity and total annual tonnes mined.

The 2011 projection for the Boggabri opencut highwall does not present a favourable alignment with respect to punch longwall mining. The alignment of the final main highwall allows for only 3 or 4 longwall blocks on each seam level and these head straight into the heavily seam parted zones, with only relatively short length until the limiting A339 lease boundary is met.

A redesign of the opencut layout by opening up coal exposure across the entire lease in a north-west / south-east alignment would make a huge difference to the prospect for punch longwall mining and overall reserve recoveries. It would enable the recovery of coal along the respective lox lines by open cut methods which underground mining, even bord and pillar methods, simply do not have the capability to achieve. The finished highwall would then enable a continuous line of north-east south-west orientated punch highwalls to mine up to the northern and eastern CL368 lease boundary.

A hybrid method would allow opencut and underground operations to co-exist for many years and would be necessary to allow for excavation of the open cut floor down to the next seam level once each upper seam level is completed.

10.3.4 Braymont Seam Extended Opencut

Significant reserves on the Braymont level are steralised or have potential to be sterilised as a result of limited depth of cover. The option of extending the open cut into these zones while counter to land disturbance minimisation would need to be investigated.

It may be considered that to completely mine the Braymont seam by open cut methods, and thus maximise the recovery of these thicker coal measures, may be an optimisation of the resource. A longwall could then be designed to target the lower Jeralong and Merriown seams, which with similar seam thickness would allow for more refined specificity for maximising recovery of these seams.

10.3.5 Seam Order

While it is intuitive that seams should be mined from the top down to minimise the effect that subsidence has on underlying seams, there are examples where mines have successfully operated in reverse order. Mining from the bottom up removes the potential of inrush from water and or gas from undermining of completed goafs. The nature of the massive conglomerate interburdens at Boggabri could favour this approach and would need to be investigated.

FIGURES / DRAWINGS INDEX

Figure 1.1 NSW Coal Fields

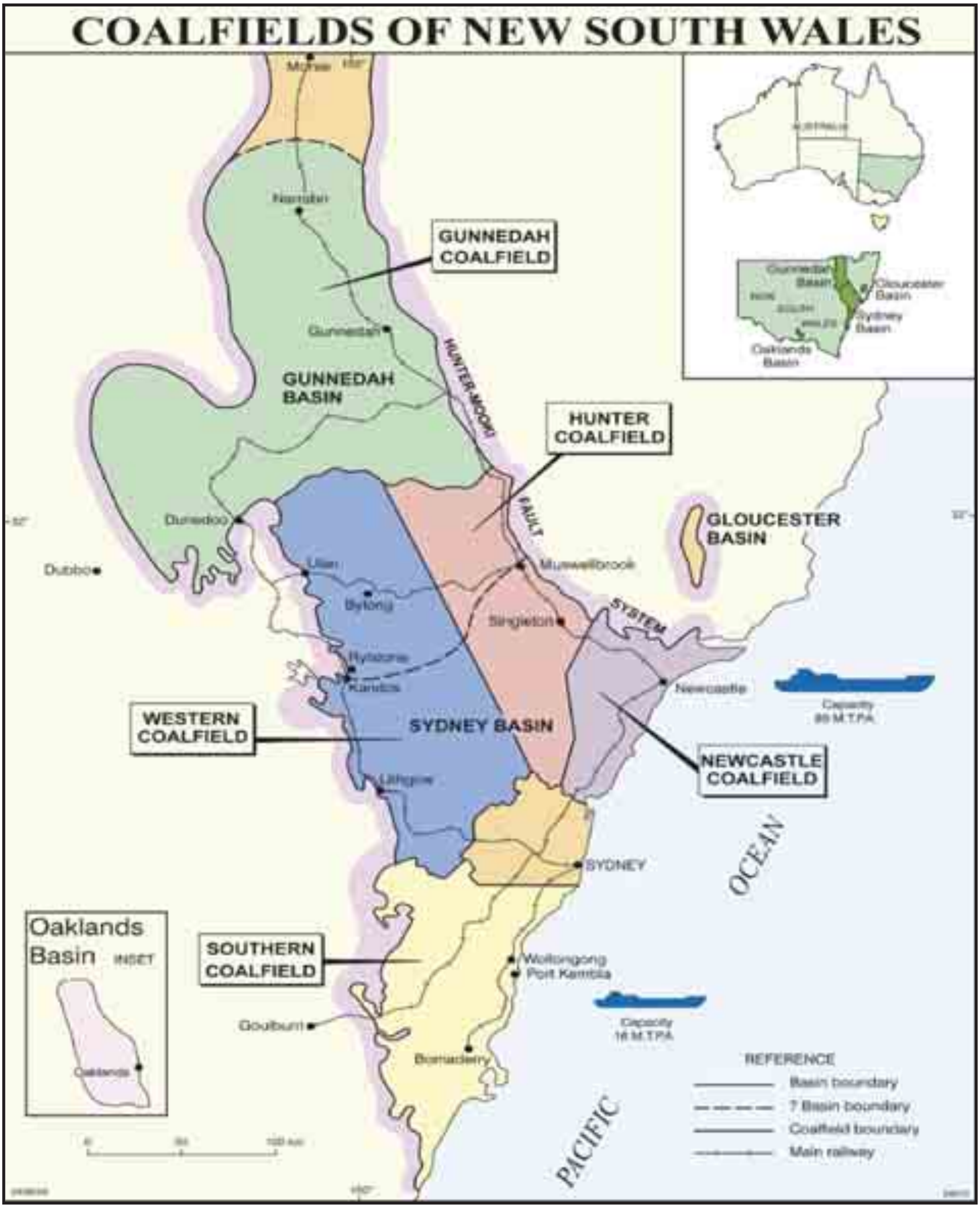


Figure 1.2 Regional Mine Location Plan

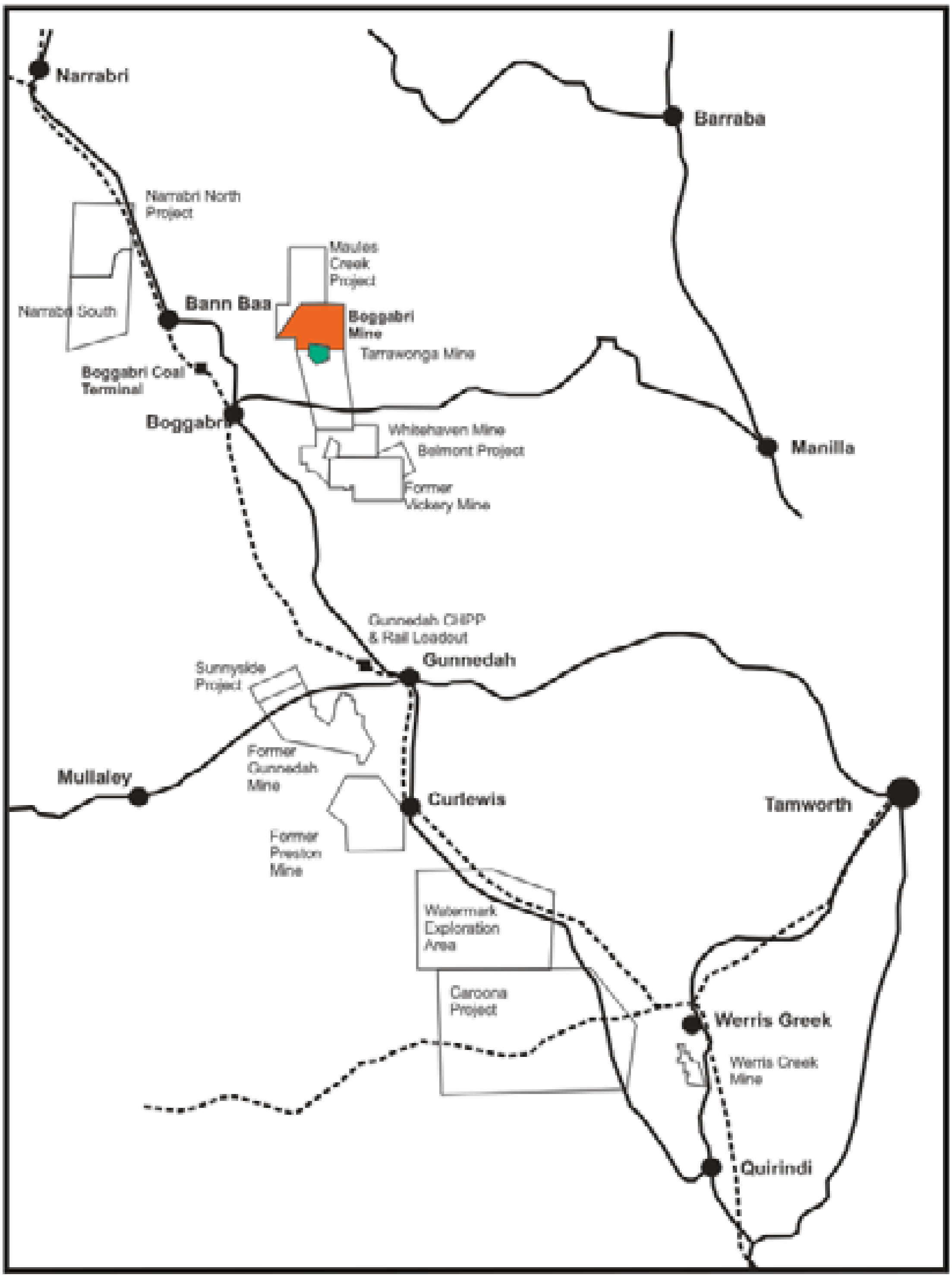


Figure 1.3 Current Approved Mining Area

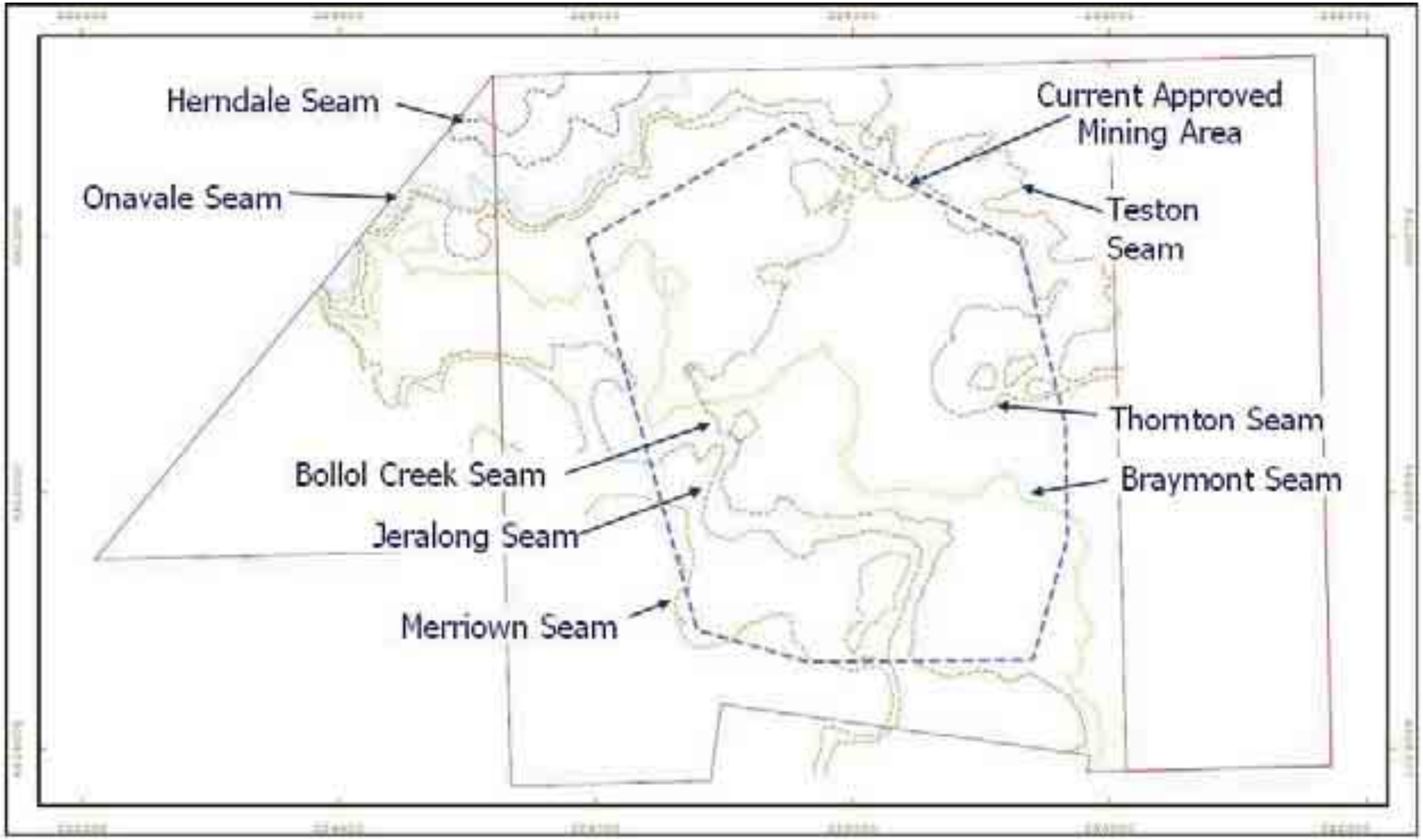
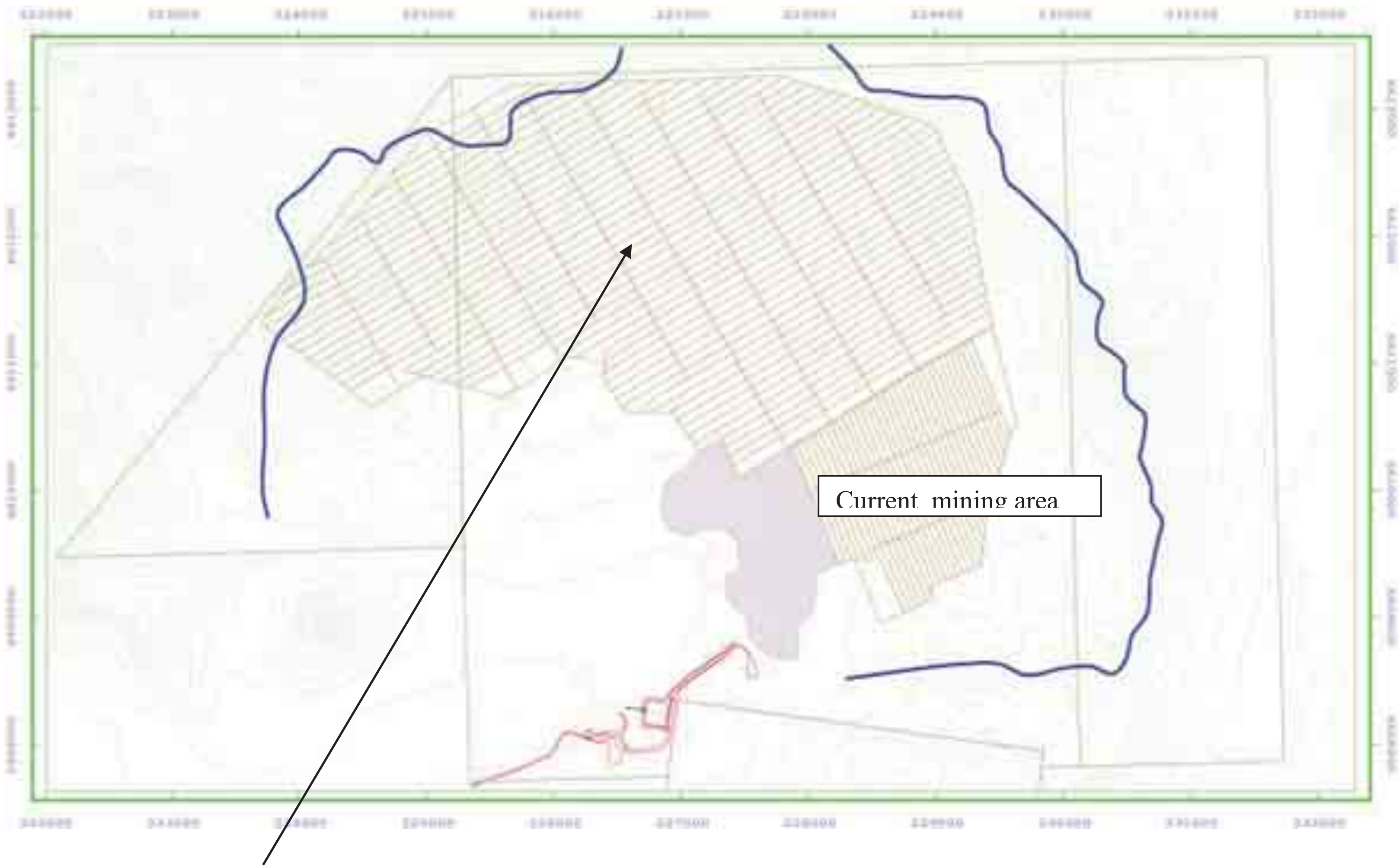


Figure 1.4 Long Term Open Cut Plan



Extended Mining Area (showing OC Strips)

Figure 1.5 Stratigraphic Column Showing Potential Underground Reserves

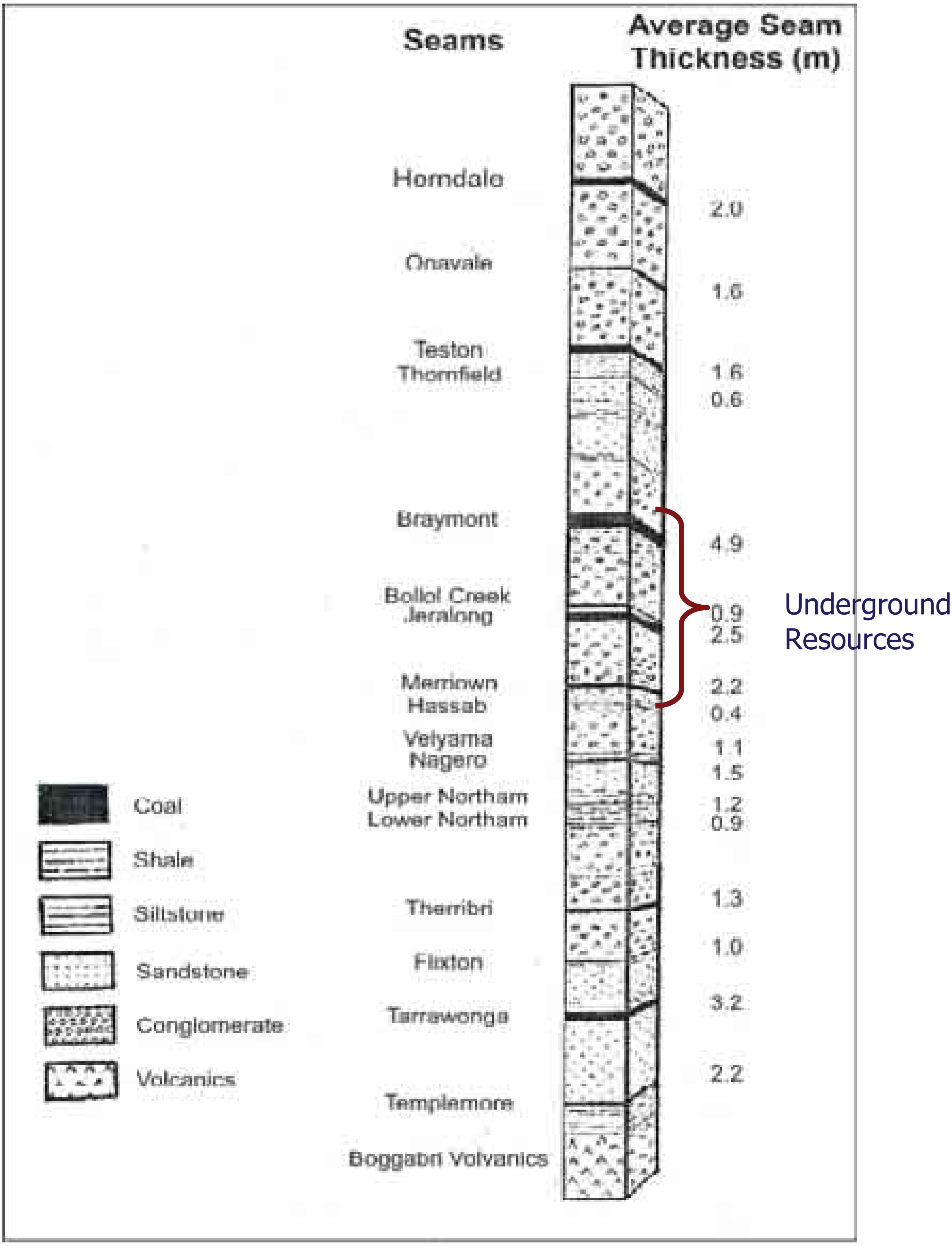


Figure 1.6 Sectional Drawing with Final Open Cut Highwall Position

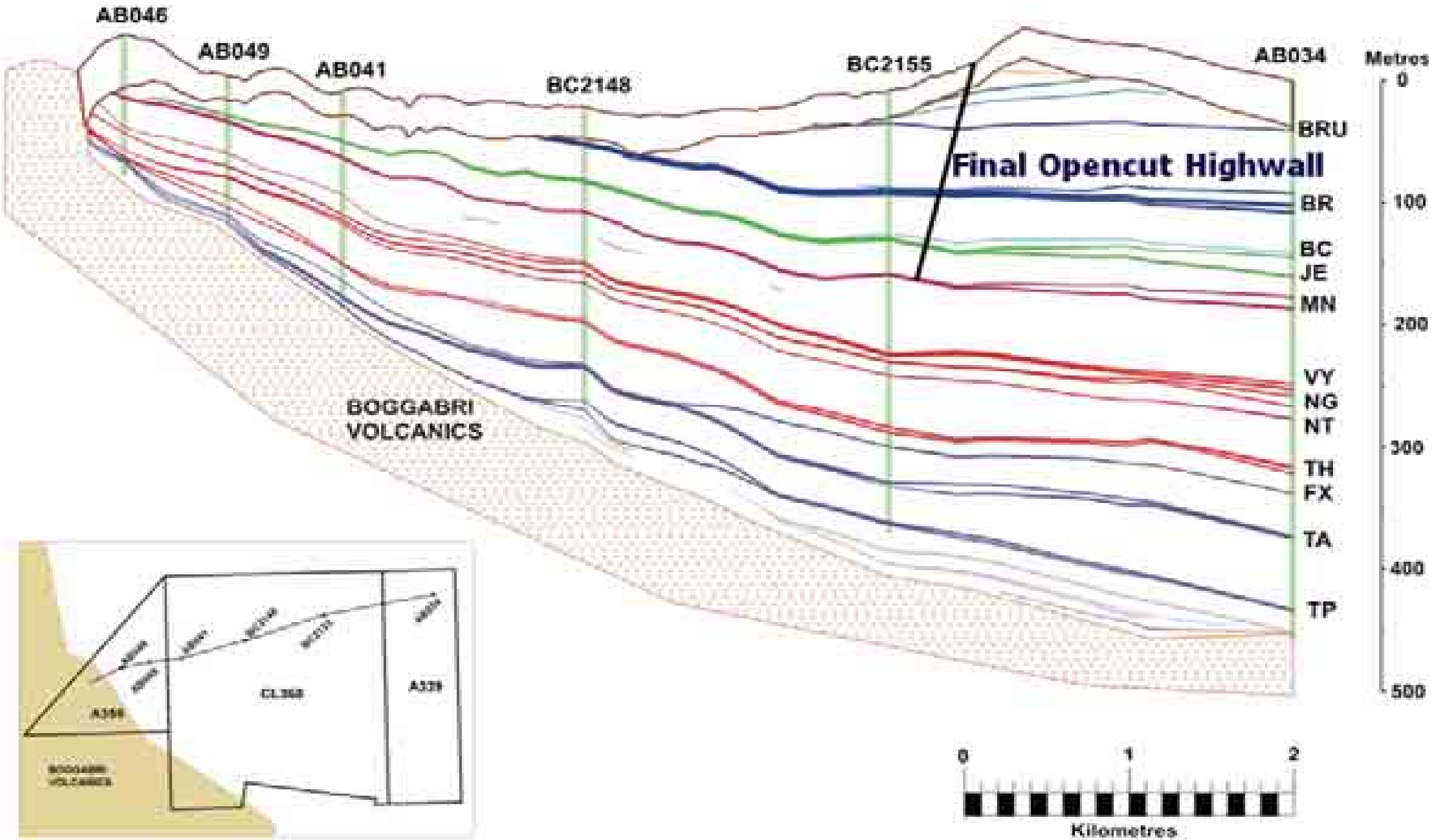


Figure 2.1 Stratigrahic Relationships in the Gunnedah Basin

<table>
<tr><th>AGE</th><th colspan="2">GUNNEDAH/BOGGABRI AREA</th><th colspan="2">HUNTER VALLEY AREA</th></tr>
<tr><td rowspan="2">LATE PERMIAN</td><td colspan="2">BLACK JACK
COAL MEASURES</td><td colspan="2">SINGLETON
COAL MEASURES</td></tr>
<tr><td colspan="2">WATERMARK FORMATION
PORCUPINE FORMATION
NO COAL</td><td colspan="2">MULBRING SILTSTONE
BRANXTON FORMATION
NO COAL</td></tr>
<tr><td rowspan="3">EARLY PERMIAN</td><td rowspan="2">NANDEWAR GROUP
(COAL MEASURES)</td><td>MAULES CREEK
FORMATION</td><td rowspan="2">GRETA
COAL MEASURES</td><td>ROWAN
FORMATION</td></tr>
<tr><td>LEARD FORMATION</td><td>SKELETAR
FORMATION</td></tr>
<tr><td colspan="2">BOGGABRI VOLCANICS
NO COAL</td><td colspan="2">DALWOOD GROUP
NO COAL</td></tr>
</table>

Figure 2.1: Stratigraphic relationships in the Gunnedah Basin

Figure 2.2 Original Permit Area Boggabri Lease

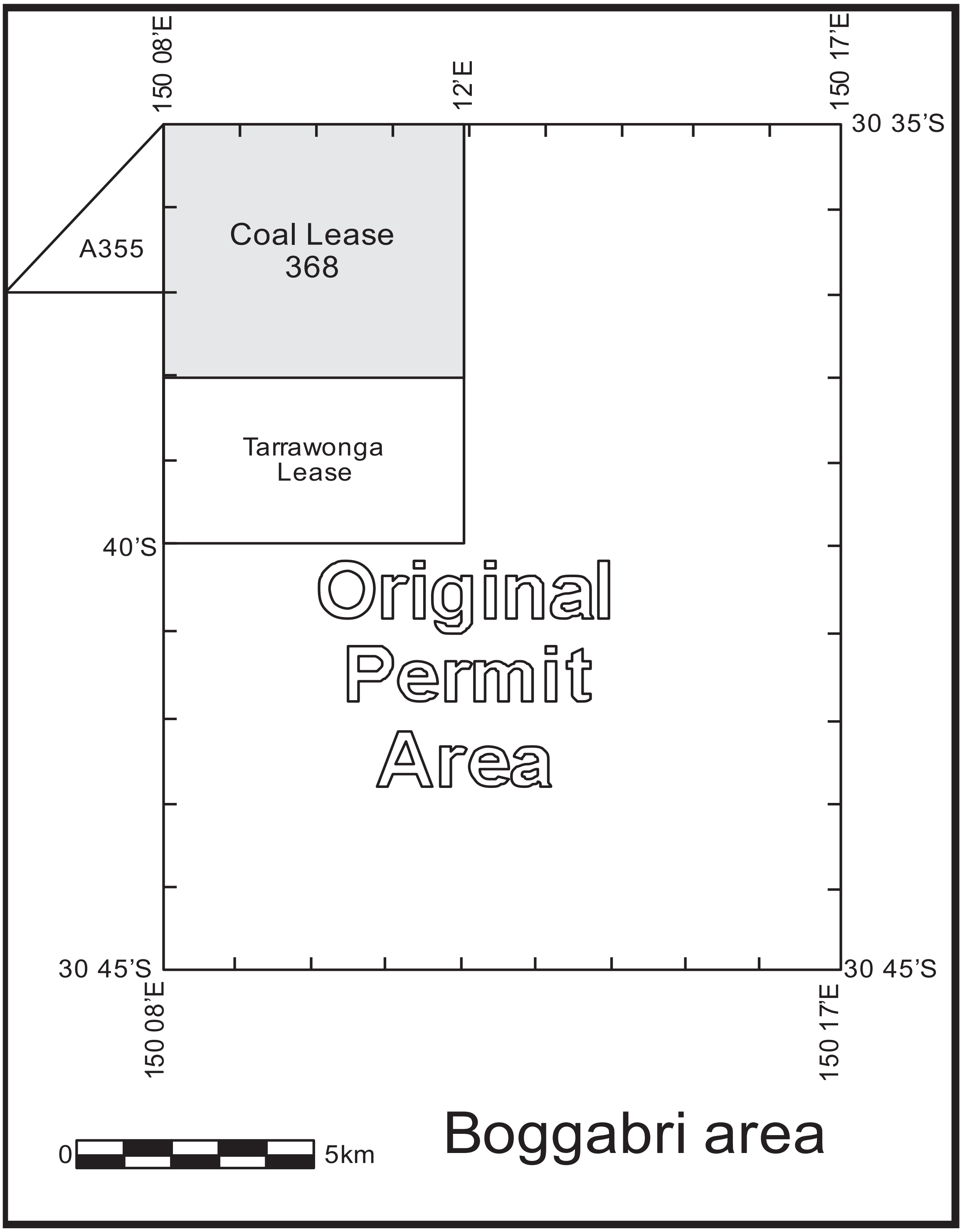
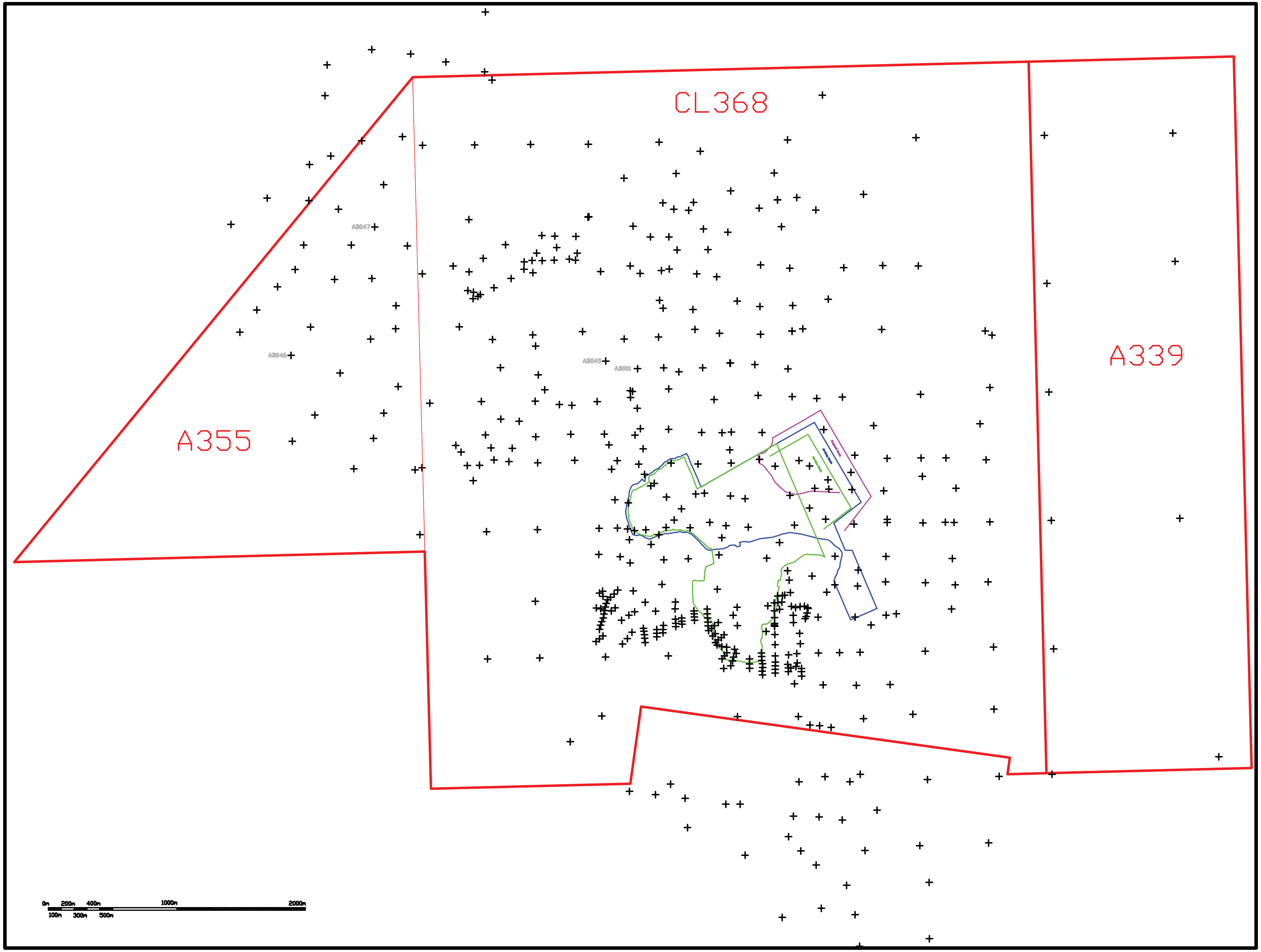
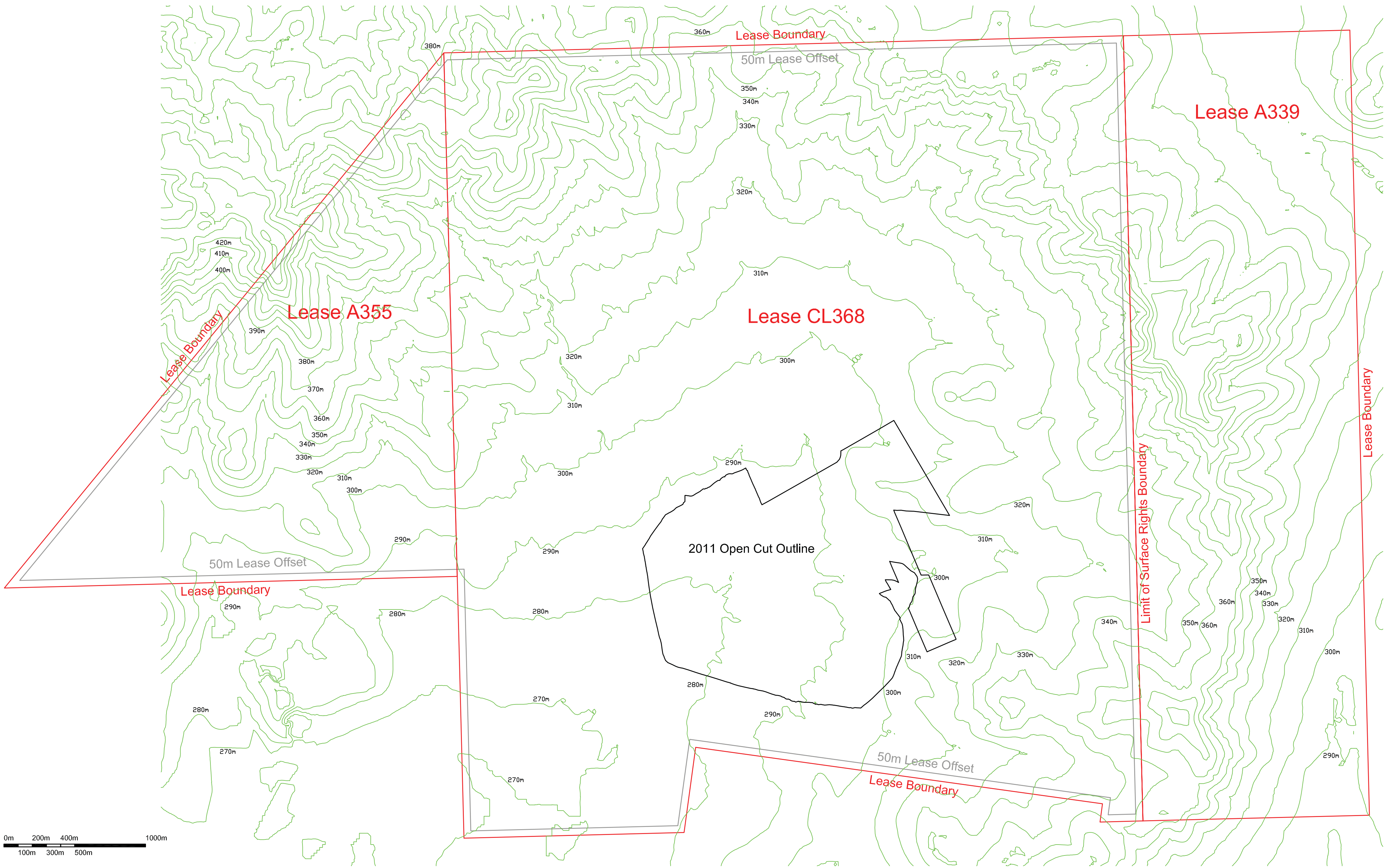


Figure 2.2: Original Permit Area, Boggabri Lease

Figure 2.3 Boggabri Borehole Location Plan





WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

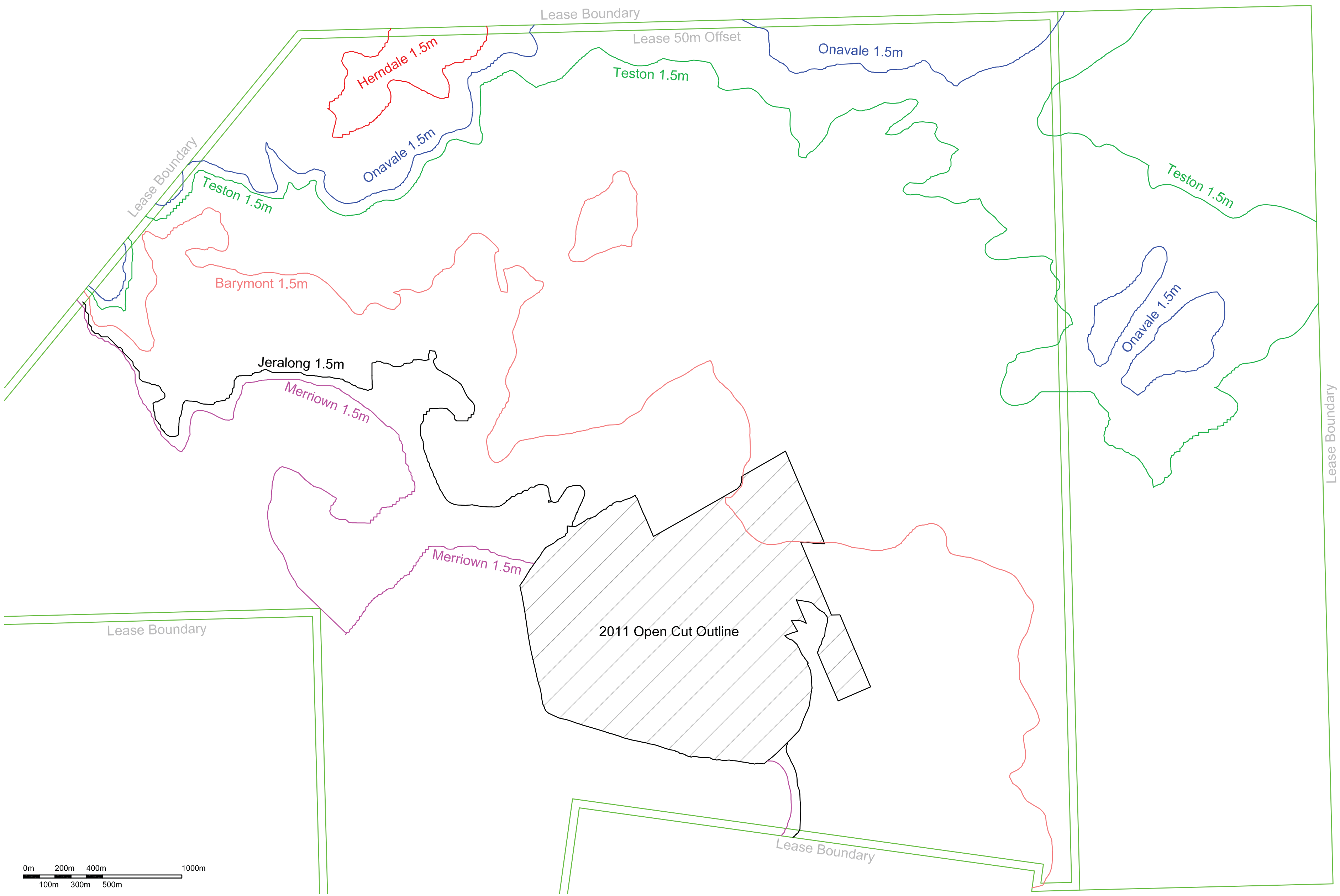
A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	3.1 LEASE AREAS.DWG				

REFERENCE DRAWINGS — DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
OVERALL CONCEPT LAYOUT
LEASE AREAS

DRAWING No : 3.1 REVISION A



REV	DATE	REVISION	BY	CKD	APPD
A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB

CAD FILE TYPE: AUTOCAD/AUTOCAD LT
CAD FILE NAME: 3.2 COMBINED SEAM OX LINES.DWG

IDEMITSU
BOGGABRI COAL

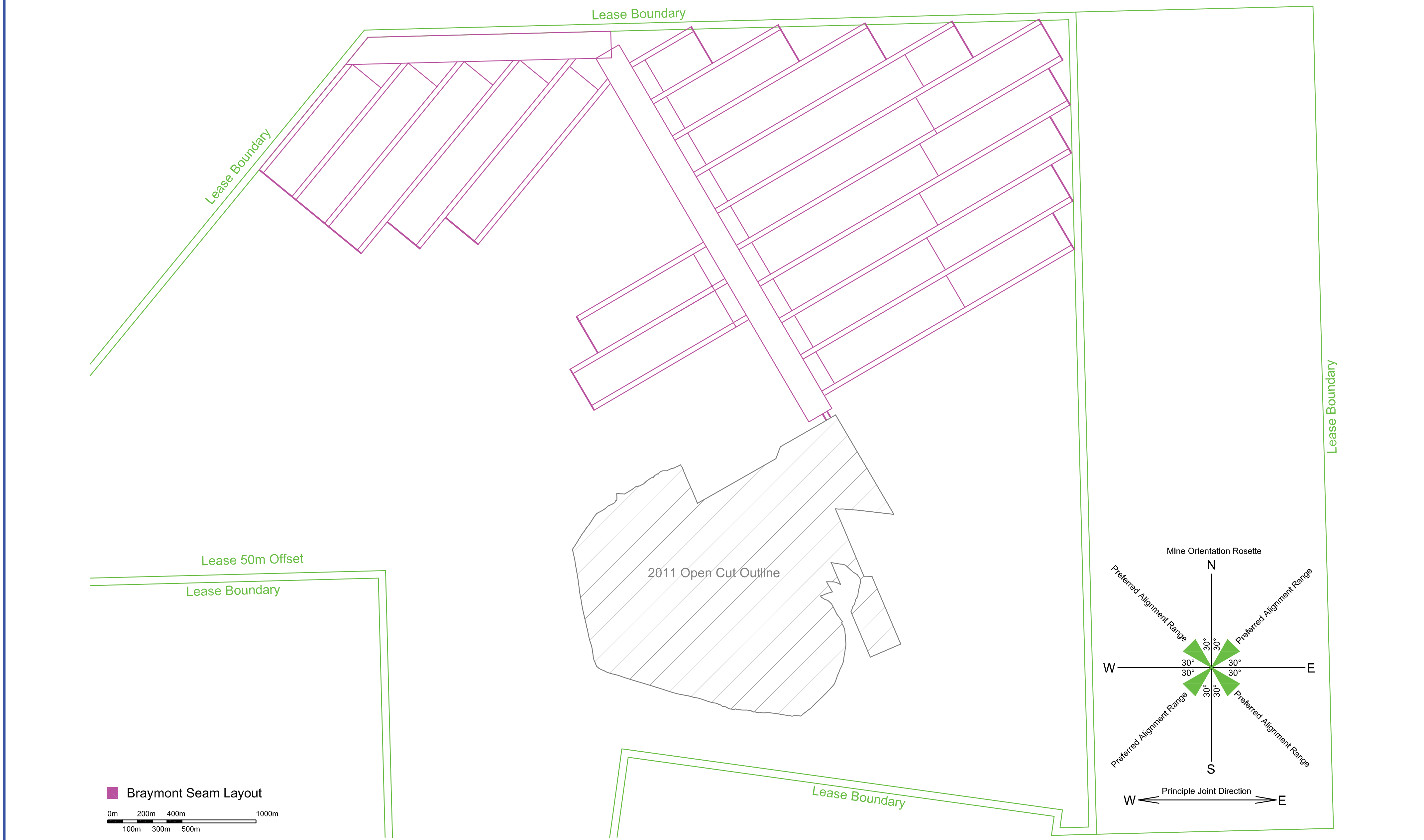
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
OVERALL LONGWALL OPTION
COMBINED SEAM OX LINES

DRAWING No : 3.2 | REVISION A



REV	DATE	REVISION	BY	CKD	APPD
A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB

CAD FILE TYPE: AUTOCAD/AUTOCAD LT
CAD FILE NAME: 3.3 MINE ORIENTATION.DWG

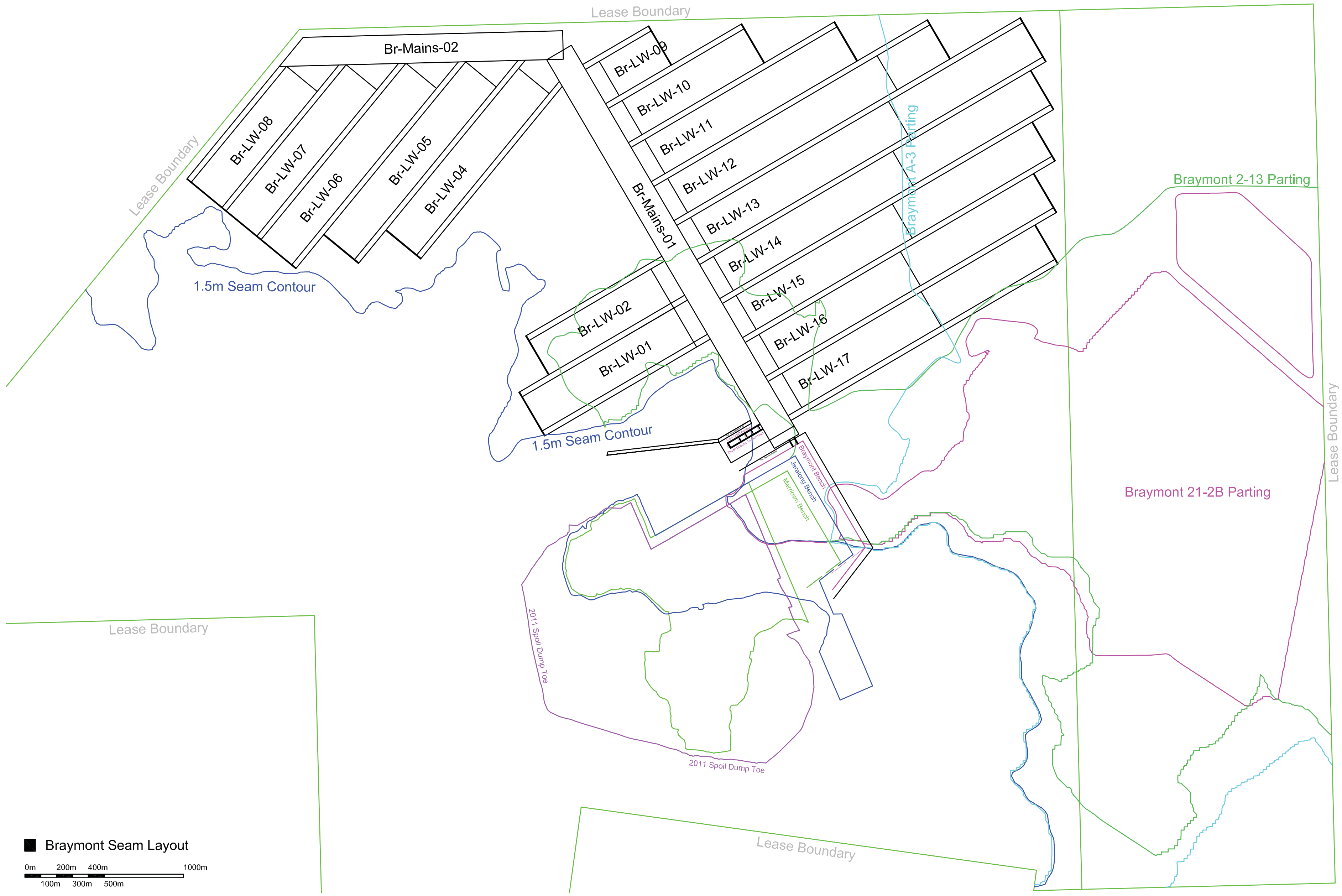
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
OVERALL LONGWALL OPTION
MINE ORIENTATION

DRAWING No : 3.3 | REVISION A



REV	DATE	REVISION	BY	CKD	APPD
A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB

CAD FILE TYPE: AUTOCAD/AUTOCAD LT

CAD FILE NAME: 3.4 BRAYMONT - LONGWALL LAYOUT.DWG

IDEMITSU BOGGABRI COAL

WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

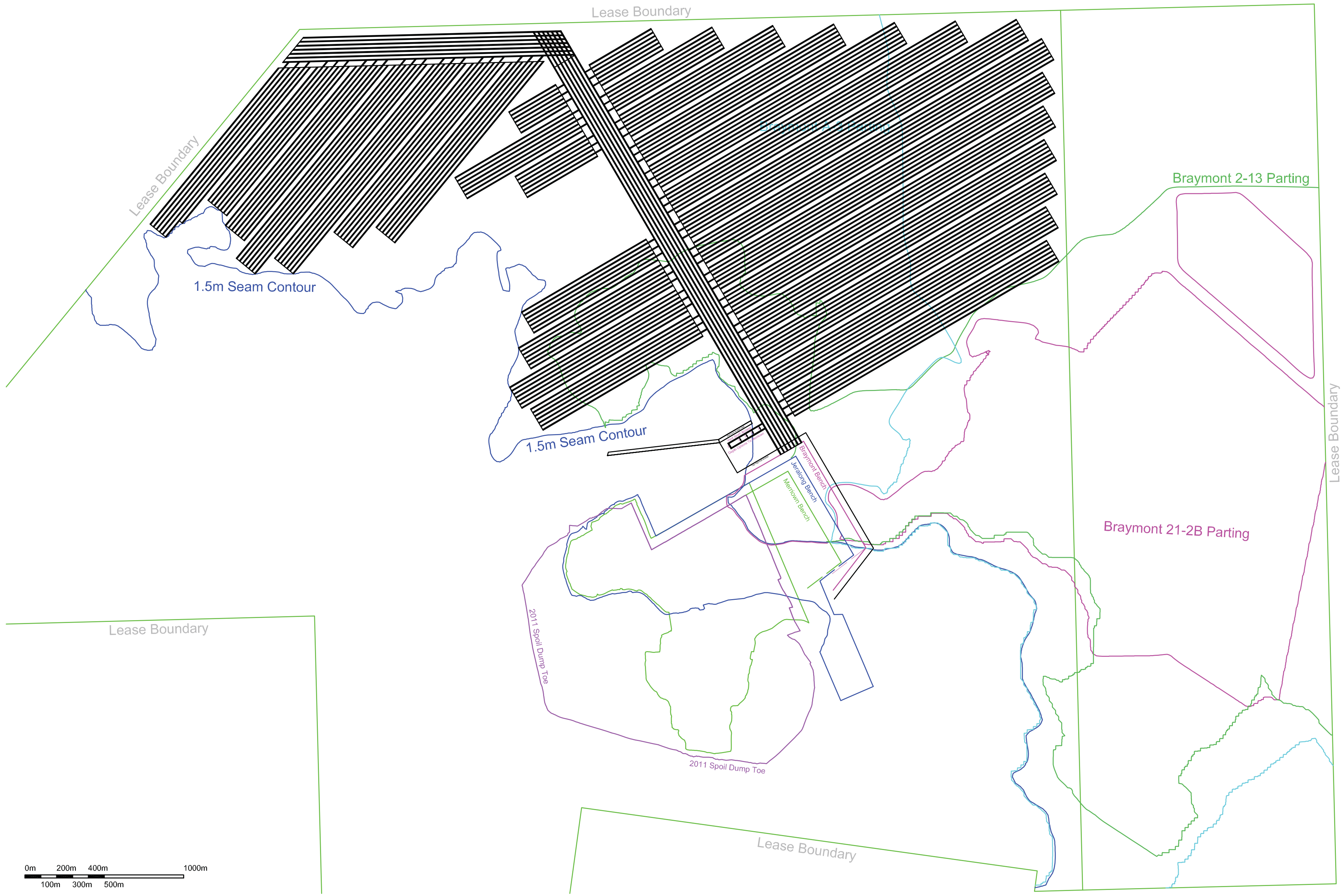
IDEMITSU

BOGGABRI UNDERGROUND CONCEPT

BRAYMONT LONGWALL OPTION

MINE LAYOUT

DRAWING No : 3.4 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	3.5 BRAYMONT - PLACE CHANGE LAYOUT.DWG				

IDEMITSU BOGGABRI COAL

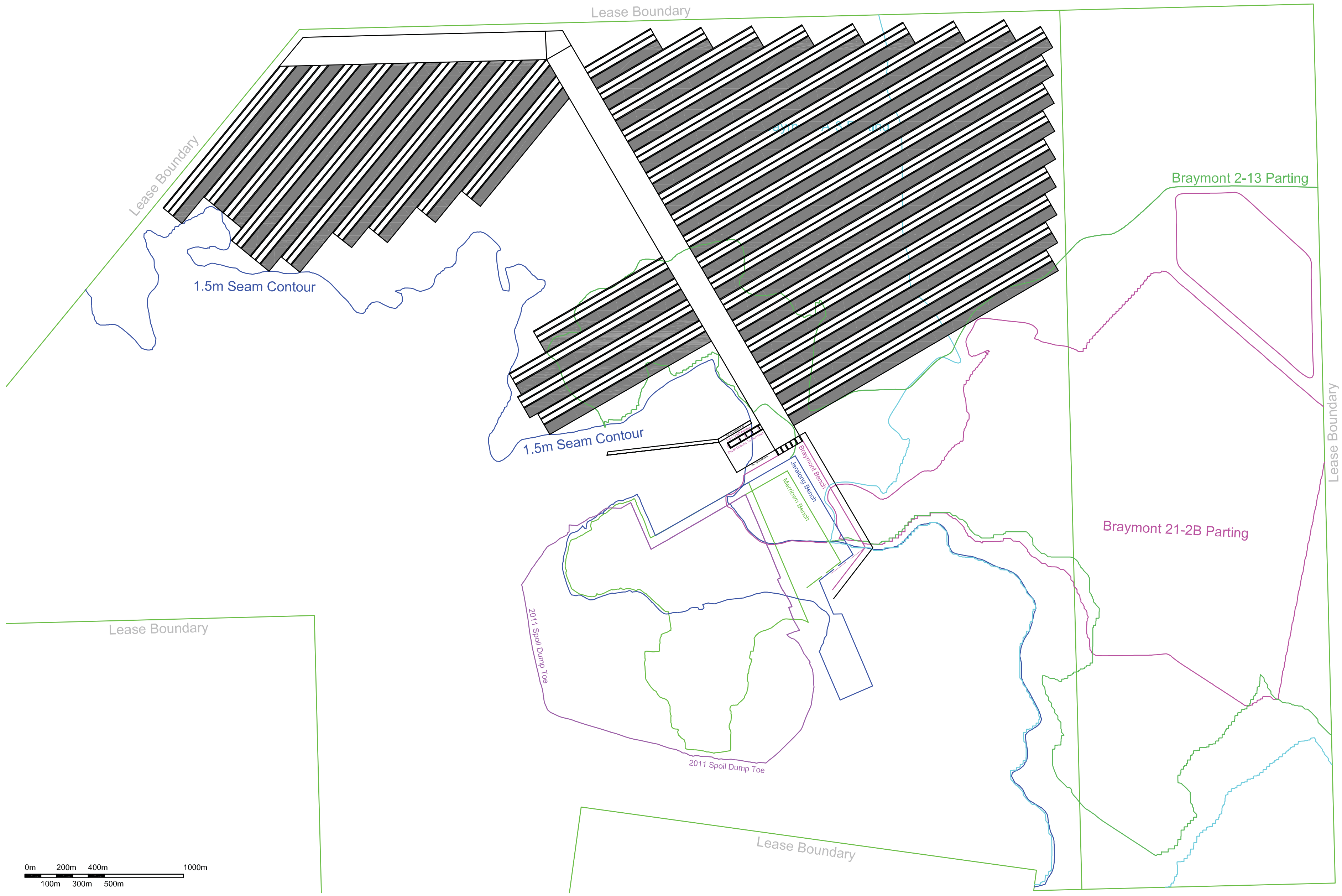
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
BRAYMONT PLACE CHANGE OPTION
MINE LAYOUT

DRAWING No : 3.5 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	3.6 BRAYMONT - WONGAWILLI LAYOUT.DWG				

IDEMITSU BOGGABRI COAL

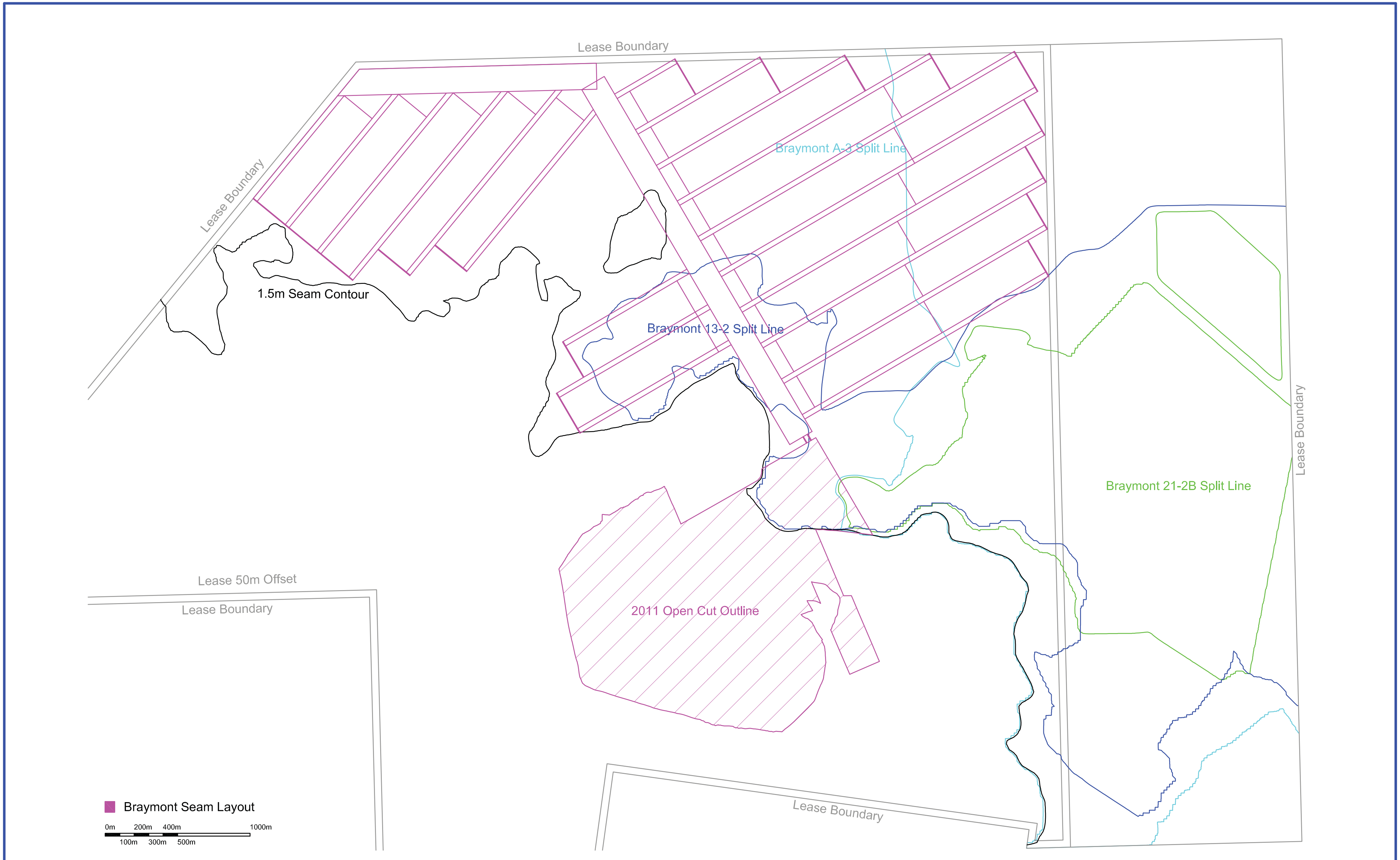
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
BRAYMONT WONGAWILLI OPTION
MINE LAYOUT

DRAWING No : 3.6 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.1 BRAYMONT - SEAM SPLIT LINES.DWG				

IDEMITSU BOGGABRI COAL

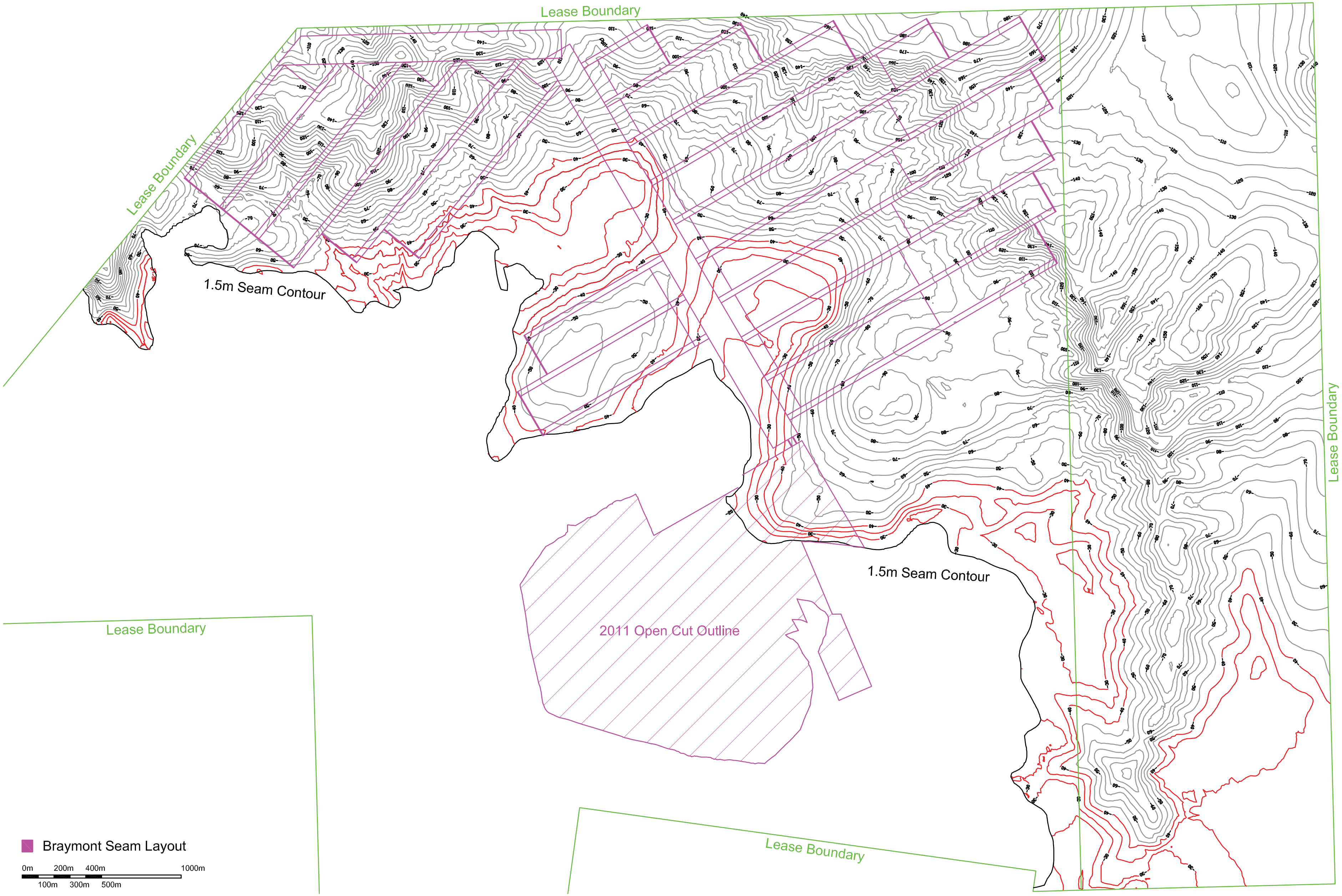
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
BRAYMONT LONGWALL OPTION
SEAM SPLIT LINES

DRAWING No : 4.1 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.2 BRAYMONT - DEPTH OF COVER CONTOURS.DWG				

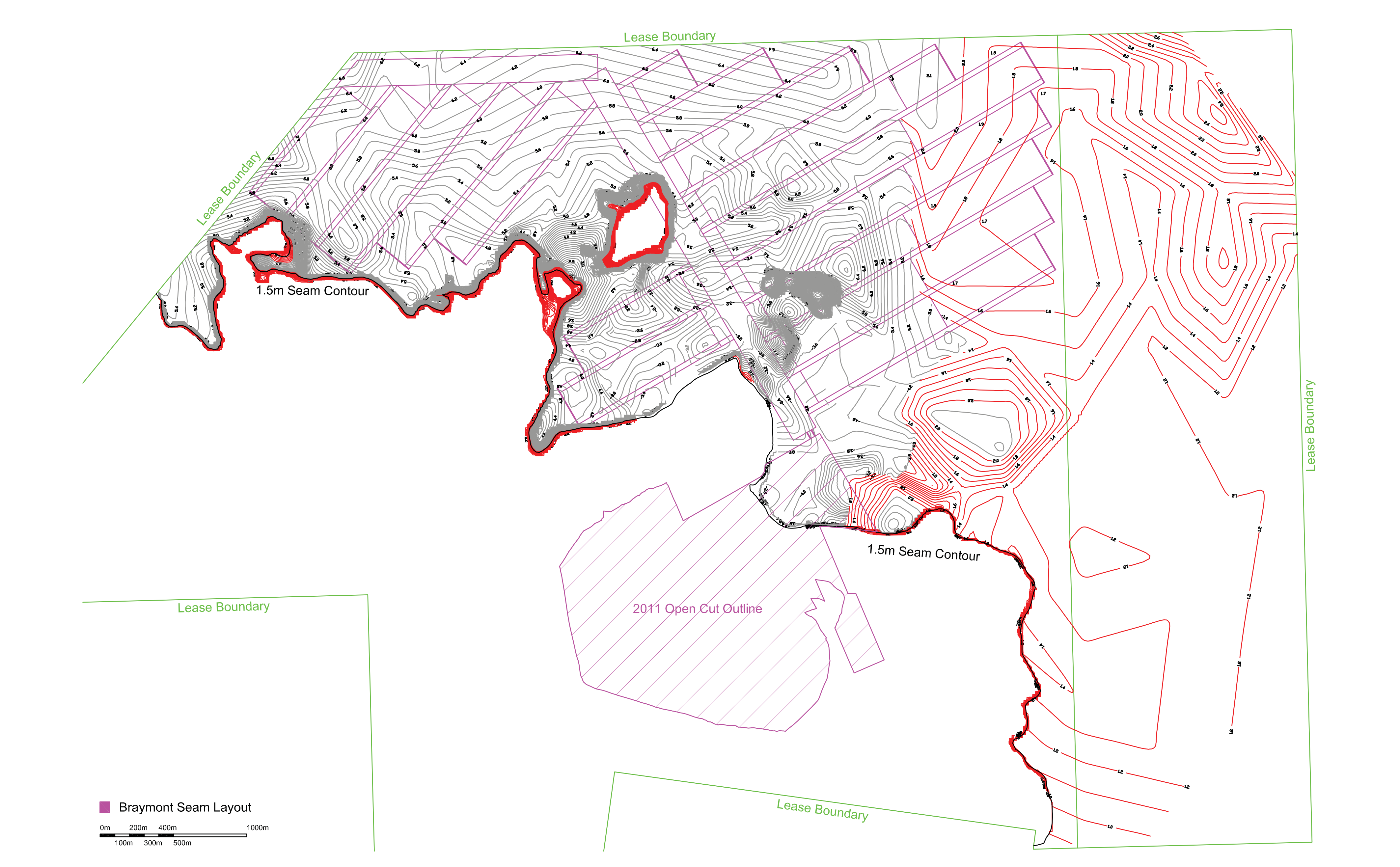
IDEMITSU BOGGABRI COAL

WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS	DRG No.	
DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
BRAYMONT LONGWALL OPTION
DEPTH OF COVER CONTOURS

DRAWING No : 4.2 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.3 BRAYMONT - COMPOSITE SEAM THICKNESS CONTOURS.DWG				

IDEMITSU BOGGABRI COAL

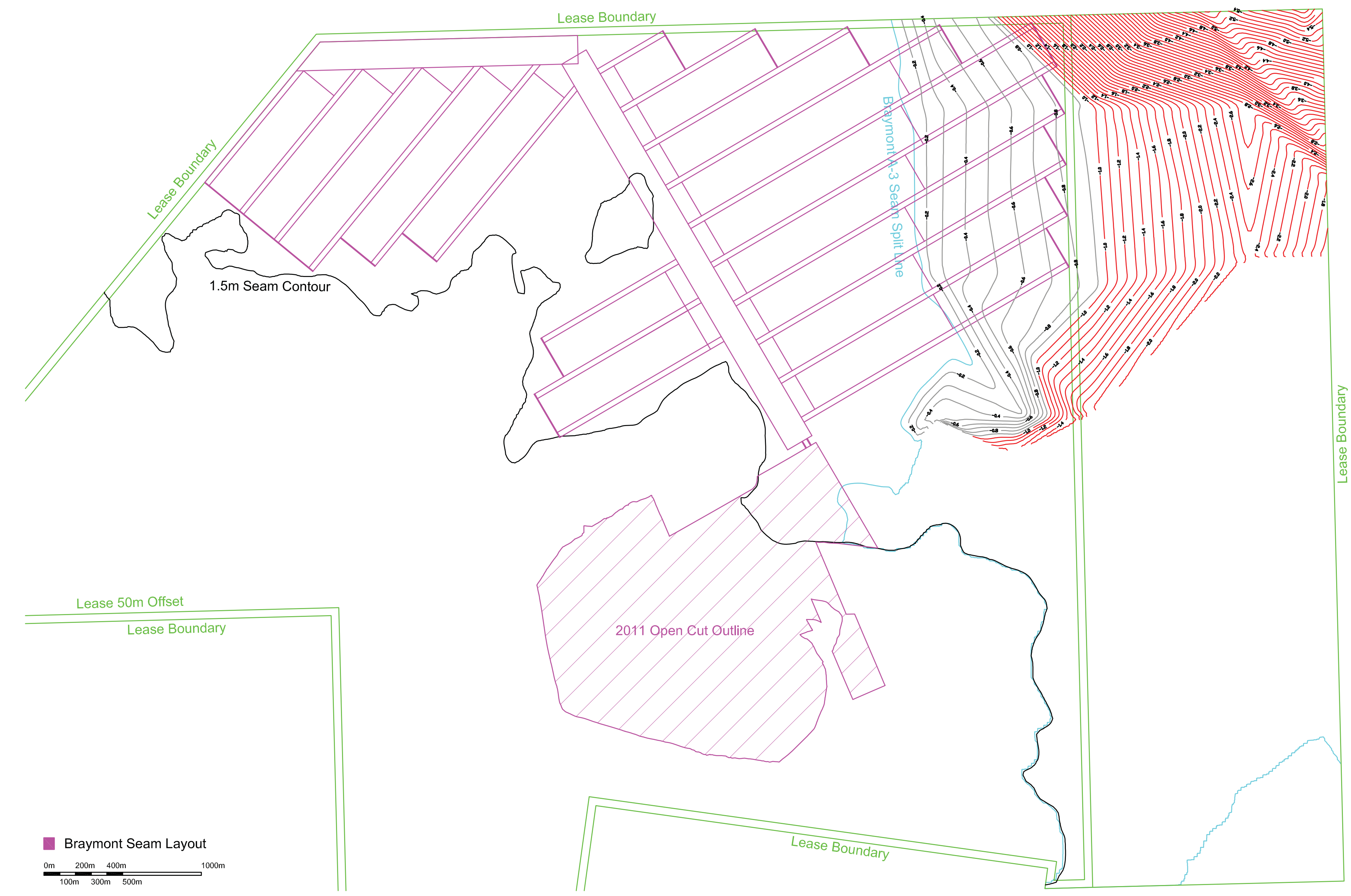
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS	DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
BRAYMONT LONGWALL OPTION
COMPOSITE SEAM THICKNESS CONTOURS

DRAWING No : 4.3 REVISION A



REV	DATE	REVISION	BY	CKD	APPD
A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB

CAD FILE TYPE: AUTOCAD/AUTOCAD LT
CAD FILE NAME: 4.4 BRAYMONT - A3 PARTING CONTOURS.DWG

IDEMITSU BOGGABRI COAL

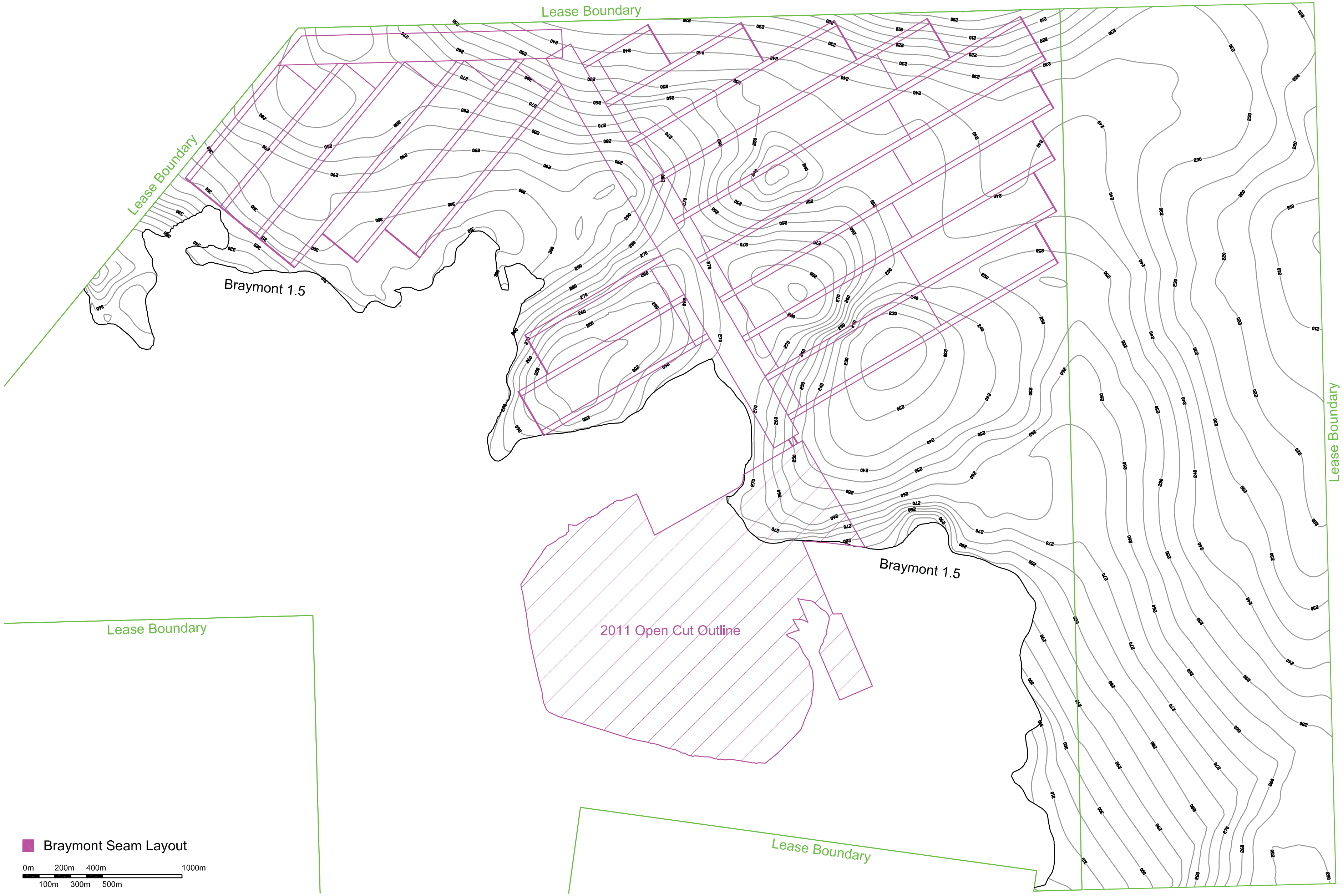
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
BRAYMONT LONGWALL OPTION
A3 PARTING CONTOURS

DRAWING No : 4.4 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.5 BRAYMONT - SEAM FLOOR RL CONTOURS.DWG				

IDEMITSU BOGGABRI COAL

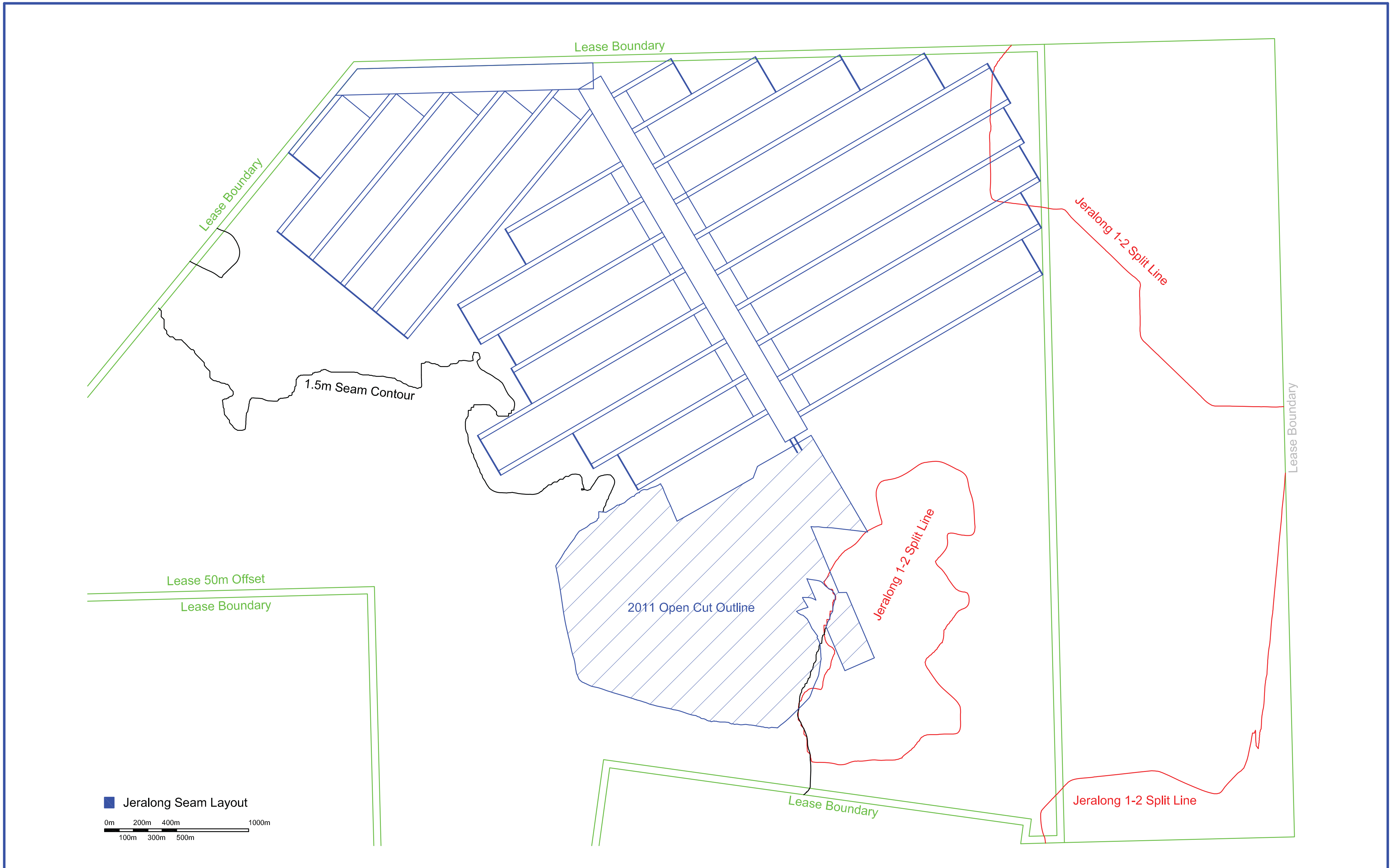
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
BRAYMONT LONGWALL OPTION
SEAM FLOOR RL CONTOURS

DRAWING No : 4.5 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.6 JERALONG - SEAM SPLIT LINES.DWG				

IDEMITSU
BOGGABRI COAL

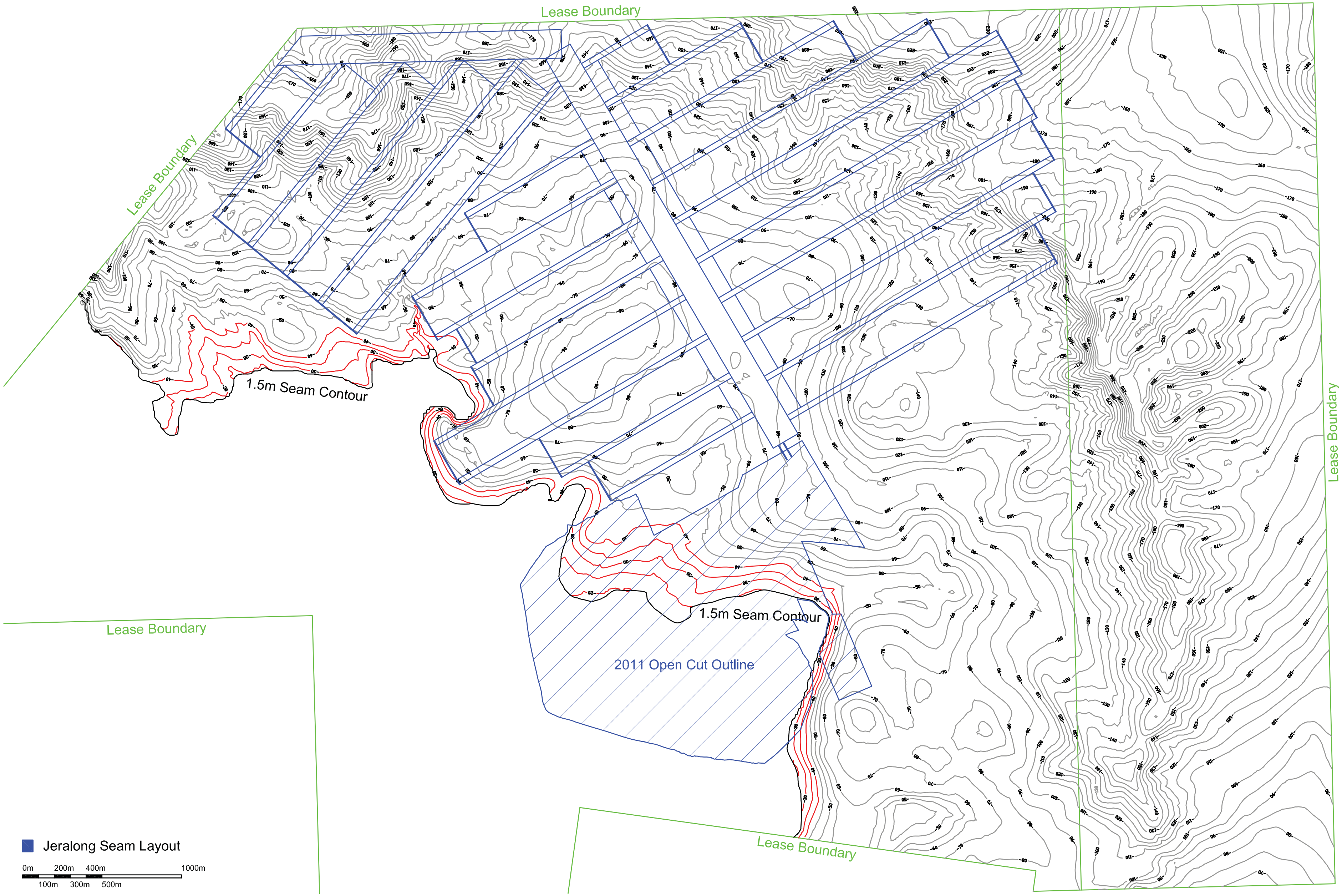
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
JERALONG LONGWALL OPTION
SEAM SPLIT LINES

DRAWING No : 4.6 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.7 JERALONG - DEPTH OF COVER CONTOURS.DWG				

IDEMITSU BOGGABRI COAL

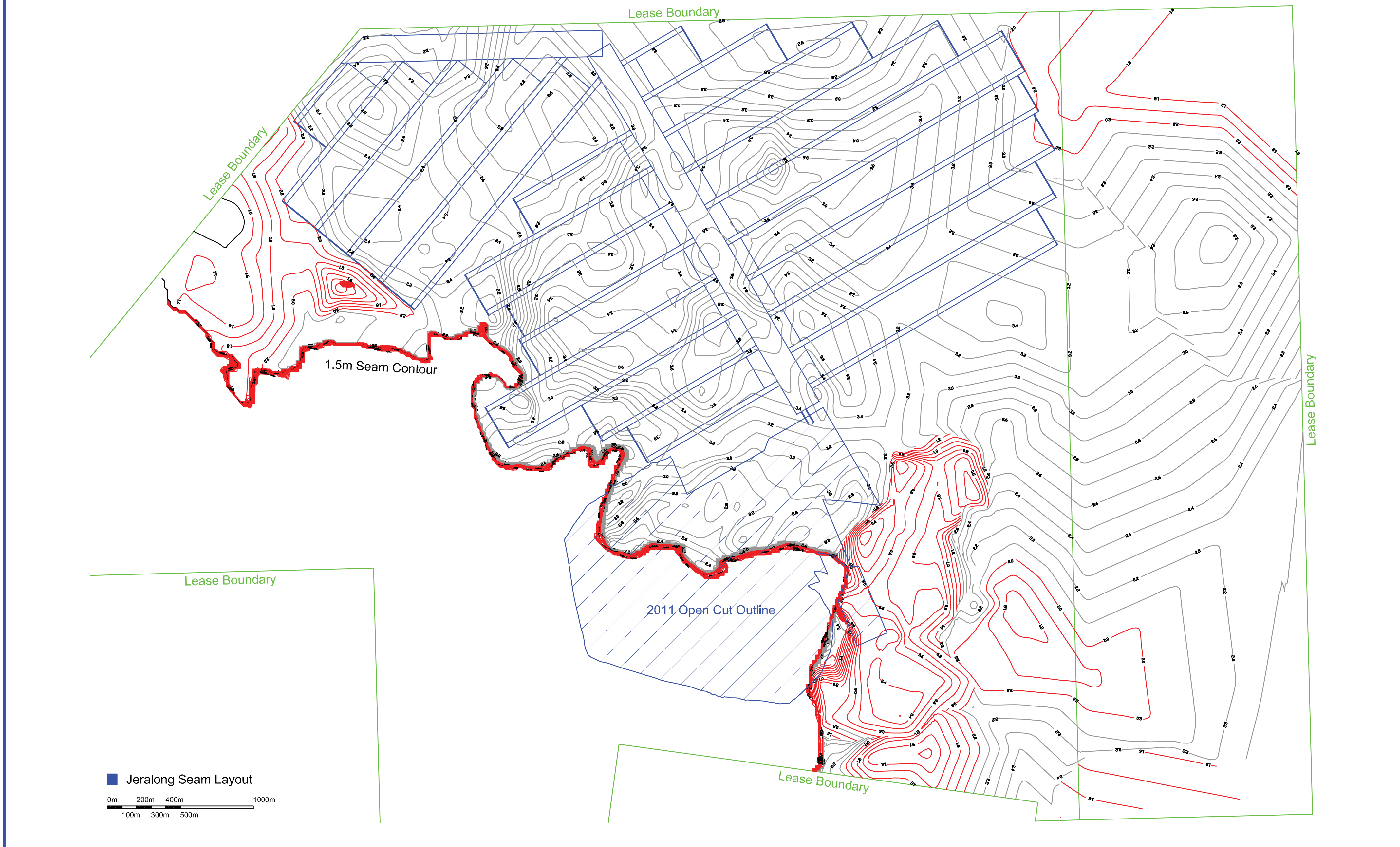
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
JERALONG LONGWALL OPTION
DEPTH OF COVER CONTOURS

DRAWING No : 4.7 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.8 JERALONG - COMPOSITE SEAM THICKNESS CONTOURS.DWG				

IDEMITSU BOGGABRI COAL

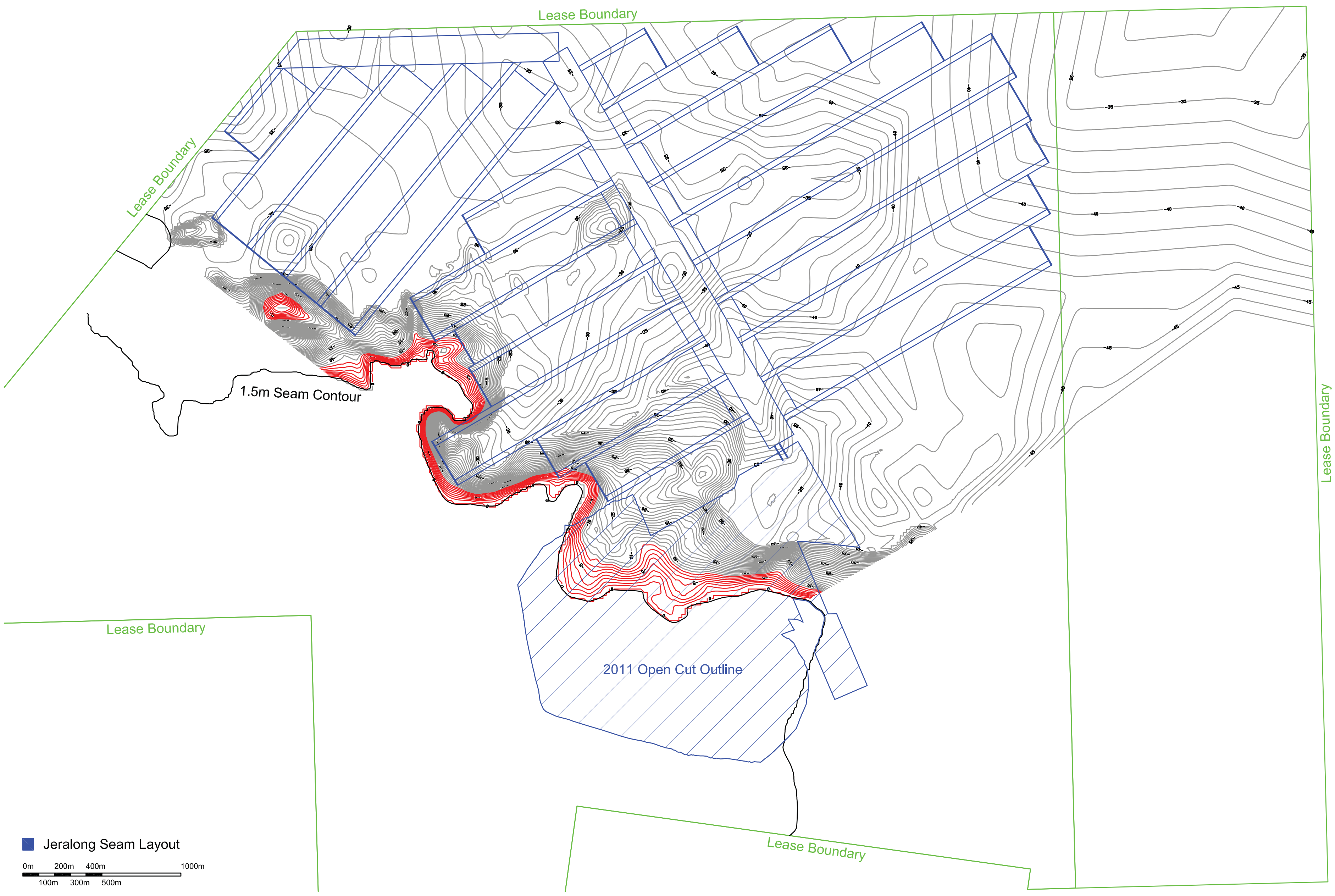
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
JERALONG LONGWALL OPTION
COMPOSITE SEAM THICKNESS CONTOURS

DRAWING No : 4.8 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.9 JERALONG - INTERBURDEN CONTOURS TO BRAYMONT.DWG				

IDEMITSU
BOGGABRI COAL

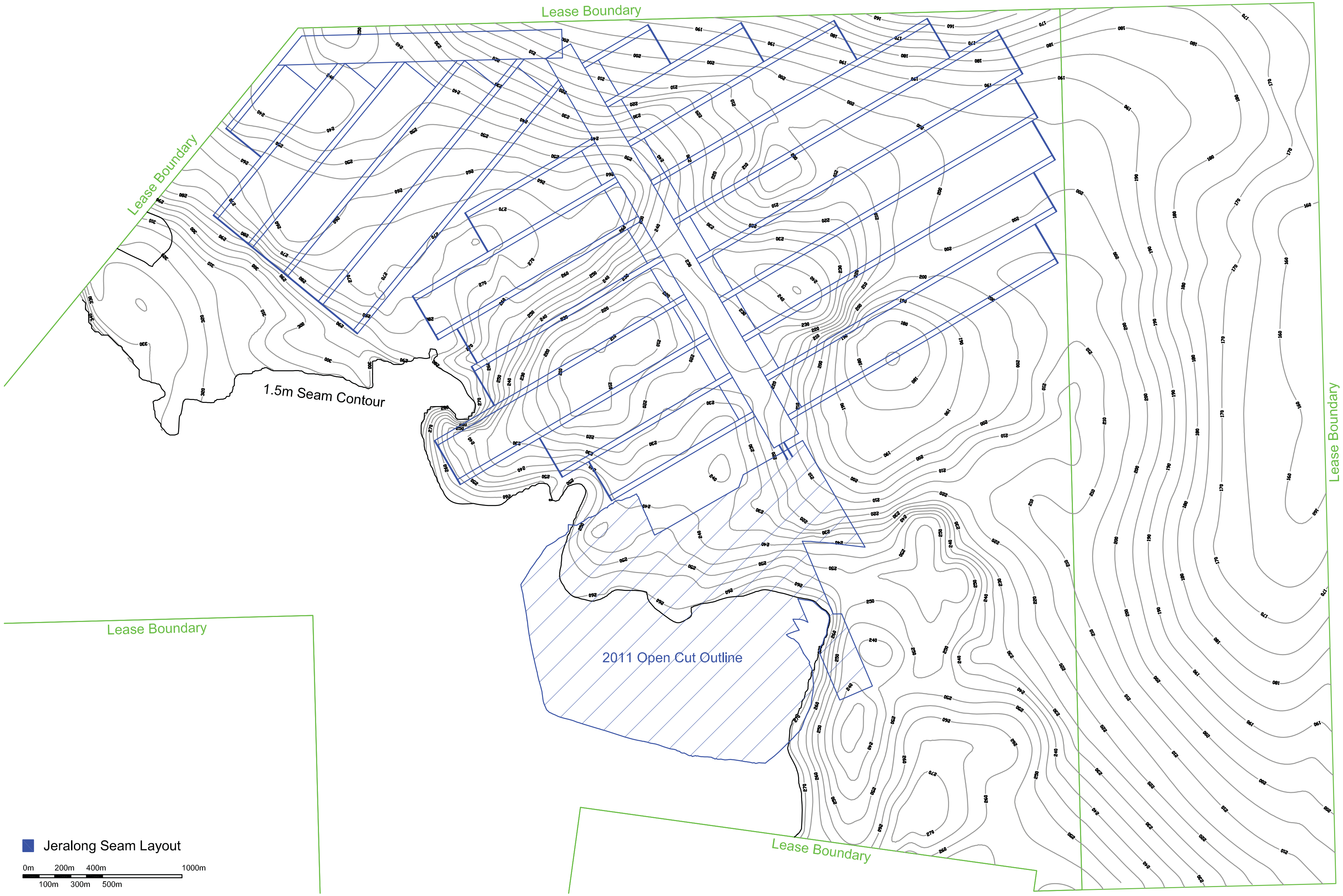
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
JERALONG LONGWALL OPTION
INTERBURDEN CONTOURS TO BRAYMONT

DRAWING No : **4.9** | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.10 JERALONG - SEAM FLOOR RL CONTOURS.DWG				

IDEMITSU BOGGABRI COAL

WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

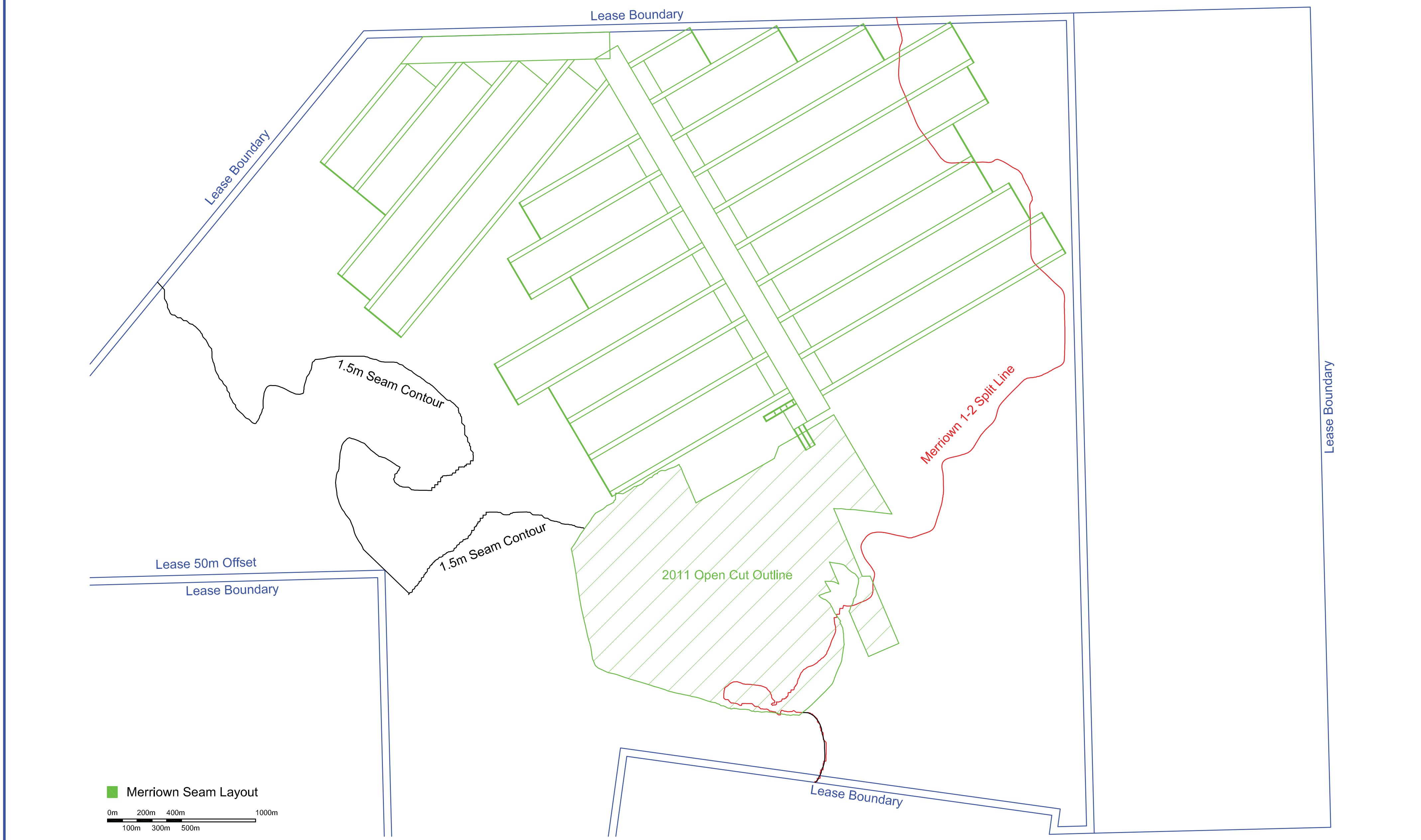
IDEMITSU

BOGGABRI UNDERGROUND CONCEPT

JERALONG LONGWALL OPTION

SEAM FLOOR RL CONTOURS

DRAWING No : 4.10 | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.11 MERRIOWN - SEAM SPLIT LINES.DWG				

IDEMITSU BOGGABRI COAL

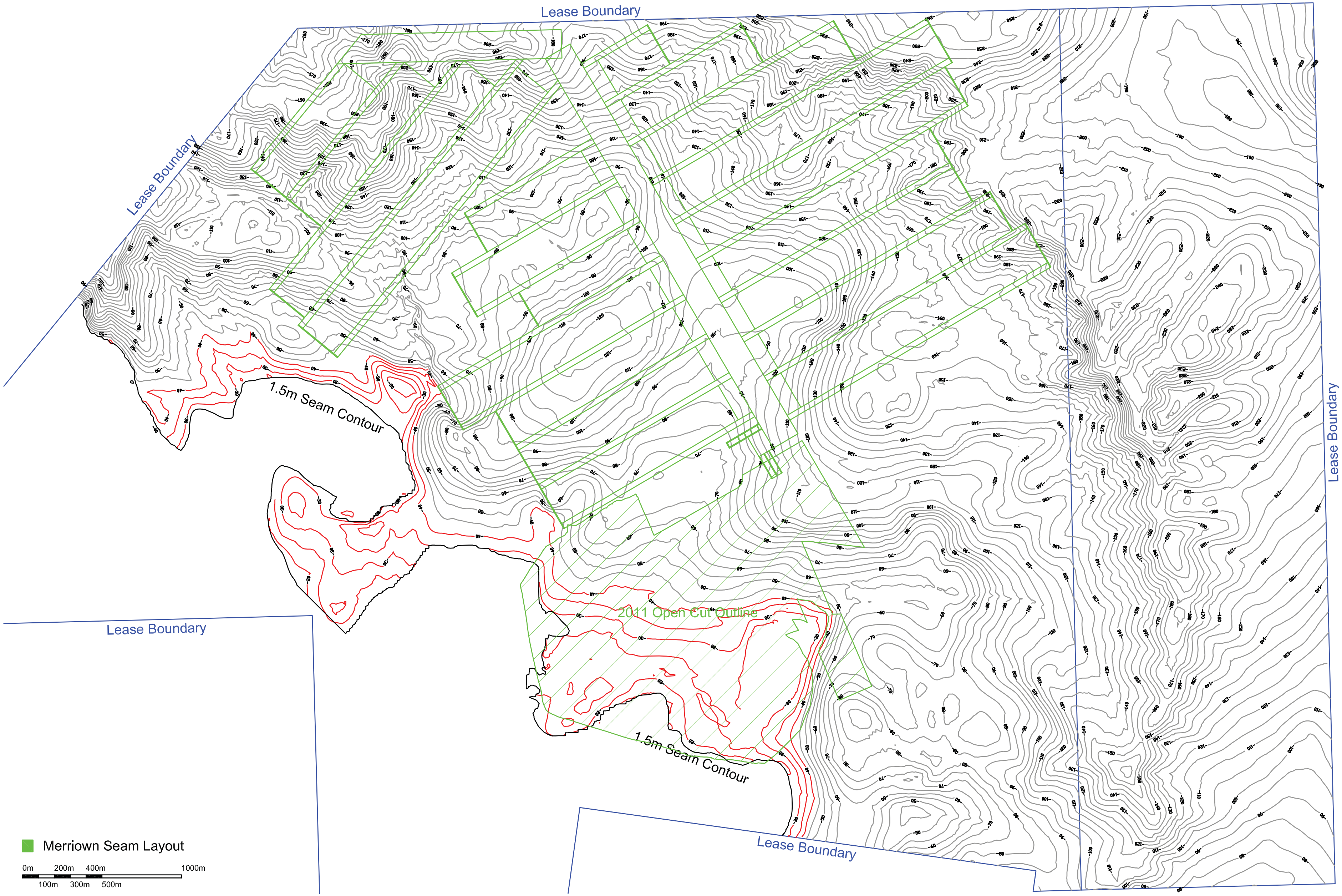
WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
MERRIOWN LONGWALL OPTION
SEAM SPLIT LINES

DRAWING No : **4.11** | REVISION A



A	23:10:09	ISSUED FOR MINE STUDY	KMF	DB	DB
REV	DATE	REVISION	BY	CKD	APPD
CAD FILE TYPE	AUTOCAD/AUTOCAD LT				
CAD FILE NAME	4.12 MERRIOWN - DEPTH OF COVER CONTOURS.DWG				

IDEMITSU BOGGABRI COAL

WDS Consulting
ABN 66 121 517 680
Level 1, 628 Coronation Drive
Toowong QLD 4066
Po Box 1374 Toowong QLD 4066
Ph: +61 7 3876 0034
Fx: +61 7 3876 0038
www.wdslimited.com.au

REFERENCE DRAWINGS | DRG No.

DESIGNED	DB	08:10:09
DRAWN	DB	08:10:09
CHECKED		
APPROVED		
SCALE	NTS	
VENDOR DRG. No.		
ORIGINAL DRAWING SIZE	A1	

IDEMITSU
BOGGABRI UNDERGROUND CONCEPT
MERRIOWN LONGWALL OPTION
DEPTH OF COVER CONTOURS

DRAWING No : 4.12 | REVISION A